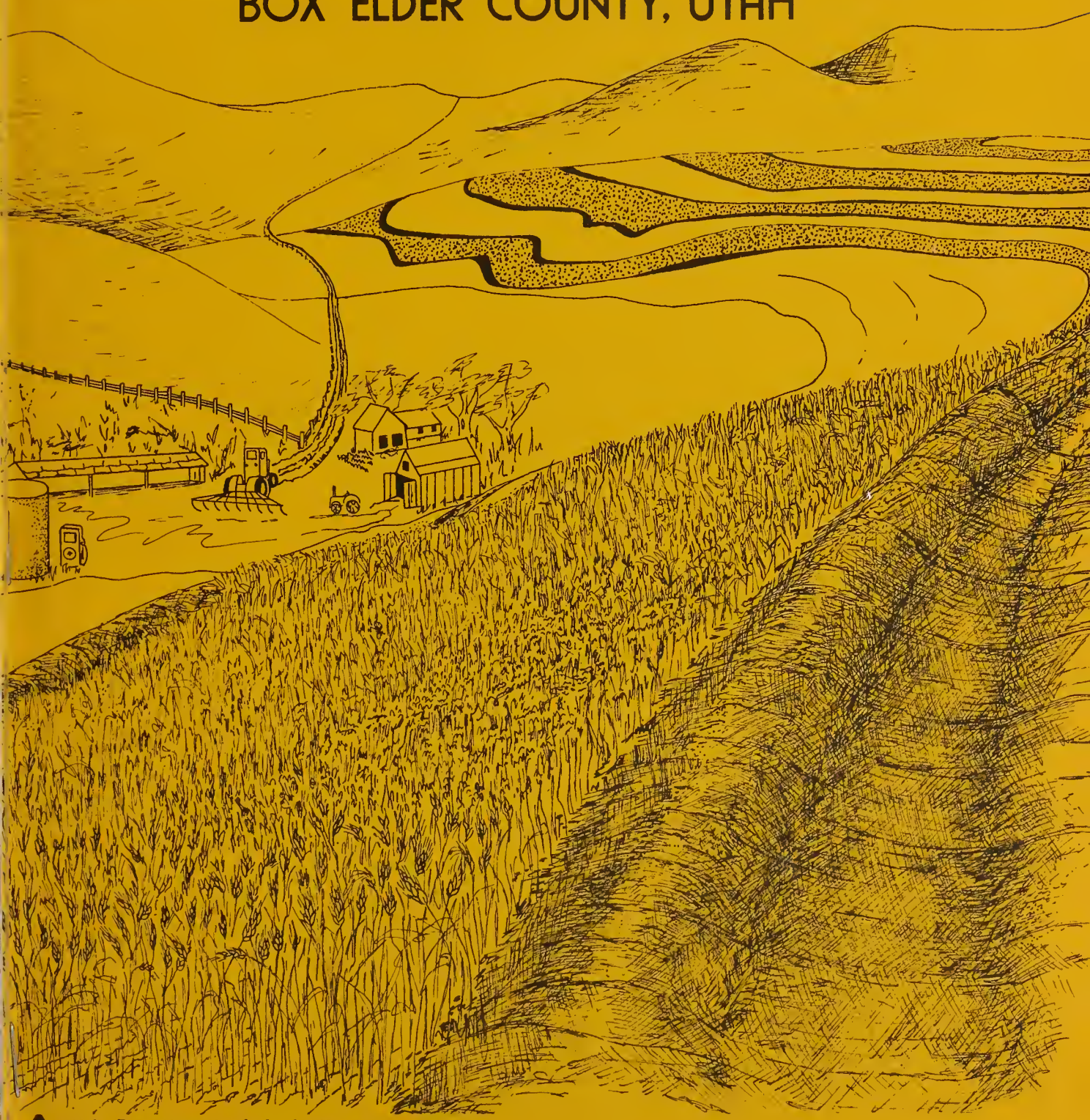
watershed work plan

HANSEL VALLEY WATERSHED

BOX ELDER COUNTY, UTAH



U.S. Department of Agriculture
Soil Conservation Service

Prepared under the authority of the Watershed Protection & Flood Prevention Act (Public law 566, 83rd. Congress, 68 Stat. 666) as amended.

This project is not a major federal action, therefore, neither an EIS nor a negative declaration was prepared.

ADDENDUM
June 1975

WATERSHED WORK PLAN
Hansel Valley Watershed

Box Elder County
Utah

CONTENTS

INTRODUCTION

This addendum is based on the Water Resources Council's Principles and Standards for Planning.

Effects resulting from evaluation of the selected Work Plan alternative are displayed under separate accounts for National Economic Development, Environmental Quality, Regional Development, and Social Well-Being.

The abbreviated environmental quality plan has been developed using information and data assembled during investigations and analysis for the Watershed Work Plan. The procedure used in developing the alternative and its contents are included on a flow chart. The alternative formulated in the Hansel Valley Work Plan enhances environmental resource opportunities in the watershed area. The cost for its installation is estimated to be $959,400.

DISCOUNT RATE COMPARISON
HANSEL VALLEY WATERSHED, UTAH

The work plan shows an evaluation of project measures using 1974 installation costs, and a discount rate of 5 7/8 percent. The total estimated project installation cost is $959,400. The average annual cost of structural measures is $25,960. The annual primary benefits are $87,750 and the annual secondary benefits are $12,720. The ratio of benefits to costs are 3.9 to 1.0 including secondary benefits and 3.4 to 1.0 without secondary benefits.

SELECTED ALTERNATIVE
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT
HANSEL VALLEY WATERSHED, UTAH

Components	Measures of Effects 1/ - - - Dollars - - -	Components	Measures of Effec - - - Dollars - -
Beneficial effects:		Adverse effects:	
A. The value to users of increased outputs of goods and services.		A. The value of resources required for a project.	
1. Flood Prevention	87,750	1. Diversions and Appurtenant structures	
		Project installation	18,560
		Project administration	2,460
		Operation,Maintenance & Replacement	4,940
Total Beneficial effects	87,750	Total adverse effects	25,960
		Net beneficial effects	61,790

1/ Average Annual

SELECTED ALTERNATIVE
ENVIRONMENTAL QUALITY ACCOUNT
HANSEL VALLEY WATERSHED
UTAH

Components	Measures of effects
eficial and adverse effects:	
Areas of natural beauty	1. Reduction of erosion and sedimentation damage will encourage vegetative growth and natural wildlife habitat. 2. Landscape pattern will change from eroded gullies to vegetated slope terrace systems.
Quality consideration of water, land and air resources.	1. Dust resulting from sediment deposition and inadequate vegetative cover will be reduced. 2. Less sediment will be carried out of the watershed, thereby reducing water pollution. 3. Soil quality will be maintained by reducing sheet, rill and gully erosion.
C. Biological resources and selected eco-systems	1. Water impoundment will improve wildlife habitat. 2. Reduced peak flow in unstable channels will contribute to the establishment of favorable upland game bird brooding areas. 3. Reduced erosion will result in improved vegetative cover for wildlife.
D. Historical, Archeological and Geological	1. Alteration of landscape may damage unknown historical, archeological or geolgical sites and known Lake Bonneville lake terraces. 2. Reduction of erosion and sedimentation will preserve unknown archeological sites. 3. Reduction of peak flows and sediment leaving the watershed will help preserve the trans-continental railroad grade.
E. Irreversible or irretrievable commitment	1. No effect to this component.

SELECTED ALTERNATIVE
REGIONAL DEVELOPMENT ACCOUNT
HANSEL VALLEY WATERSHED, UTAH

Components	Measures of Effects 1/	
	State of Utah	Rest of Nation
Income:	(Dollars)	
Beneficial effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Flood prevention	87,750	---
B. The value of output to users residing in the region from external economies.		
1. Stemming from effects	12,720	---
Total beneficial effects	100,470	

Components	Measures of Effects 1/	
	State of Utah	Rest of Nation
Income:	(Dollars)	
Adverse effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Diversions and appurtenant structures		
Project installation	870	17,690
Project administration	150	2,310
Operation, Maintenance & Replacement	4,940	---
Total adverse effects	5,960	20,000
Net beneficial effects	94,510	-20,000

1/ Average Annual

SELECTED ALTERNATIVE
REGIONAL DEVELOPMENT ACCOUNT (Continued)
HANSEL VALLEY WATERSHED, UTAH

Components	Measures of Effects	
	State of Utah	Rest of Nation
...nents		
...yment:		
...neficial effects:		
Increase in number and types of jobs		
1. Employment for agricultural production	0.9 permanent semi-skilled jobs	-----
2. Employment for project installation	5.4 semi-skilled jobs for one year	-----
3. Employment for project OM & R	0.5 permanent semi-skilled job	-----
4. Employment in services and trade activities stemming from project operation	7.3 semi-skilled jobs for one year	-----
...otal beneficial effects	12.7 semi-skilled jobs for one year and 1.4 permanent semi-skilled jobs	

Components	Measures of Effects	
	State of Utah	Rest of Nation
Employment:		
Adverse effects:		
A. Decrease in number and types of jobs	0	0
Total adverse effects	0	0
Net beneficial effects	12.7 semi-skilled jobs for one year and 1.4 permanent semi-skilled jobs	

SELECTED ALTERNATIVE
REGIONAL DEVELOPMENT ACCOUNT (Continued)
HANSEL VALLEY WATERSHED, UTAH

Components	Measure of Effects	
	State of Utah	Rest of Nation
Regional Economic Base and Stability		
Beneficial effects:	The project will reduce erosion and sedimentation on 31,000 acres of cropland. Crop yields will increase as a result of stabilized soil movement. Project installation, operation, and maintenance, increased crop production, and increased services associated with the project will provide 12.7 semi-skilled jobs for one year, and 1.4 permanent semi-skilled jobs for the unemployed and underemployed of the region.	---
Adverse effects:	---	---

SELECTED ALTERNATIVE
SOCIAL WELL-BEING ACCOUNT
HANSEL VALLEY WATERSHED
UTAH

Components	Measures of Effects
Beneficial and adverse effects:	
A. Real Income Distribution	1. Creates 12.7 semi-skilled jobs for one year and 1.4 permanent semi-skilled jobs. 2. Creates regional income benefit distribution of $87,750 by income class as follows:

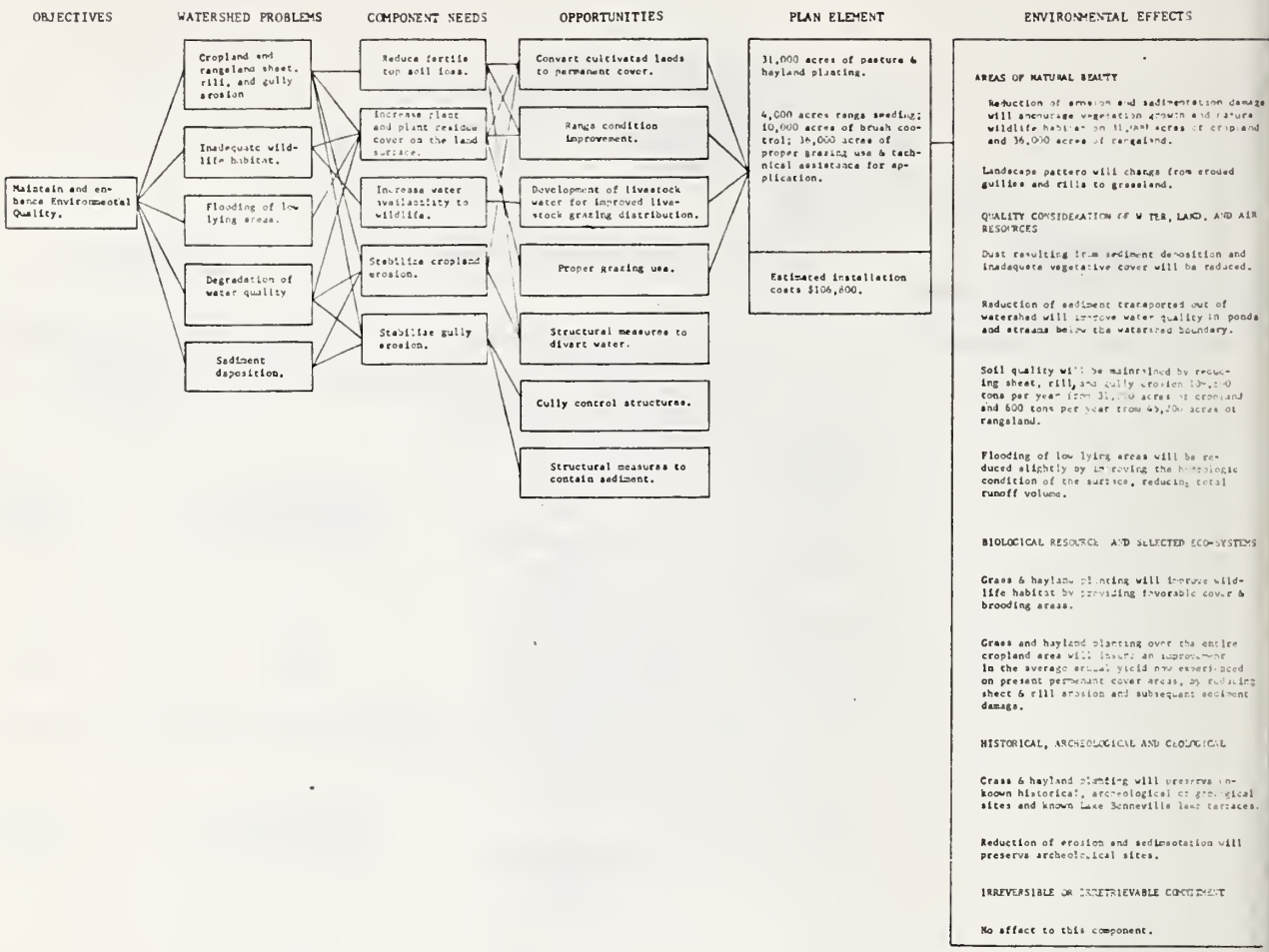
Income Class	Percentage of Adjusted Gross Income in Class	Percentage Benefits in Class
--Dollars--		
Less than 10,000	25	25
10,000 to 30,000	50	50
More than 30,000	25	25

3. Local cost to be borne by region total $5,930 with distribution by income class is as follows:

Income Class	Percentage of Adjusted Gross Income in Class	Percentage Benefits in Class
--Dollars--		
Less than 10,000	25	25
10,000 to 30,000	50	50
More than 30,000	25	25

B. Life, health and safety	1. No effect to this component
C. Educational, cultural and recreational	1. No effect to this component

ENVIRONMENTAL QUALITY ALTERNATIVE
HANSEL VALLEY WATERSHED, UTAH



WATERSHED WORK PLAN AGREEMENT

between the

Hansel Valley Watershed District

Box Elder County

Northern Utah Soil Conservation District

(hereinafter referred to as the Sponsoring Local Organization)

State of Utah

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works-of-improvement for the Hansel Valley Watershed, State of Utah, under the authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works-of-improvement for the Hansel Valley Watershed, State of Utah, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works-of-improvement as set forth in said plan can be installed in about 10 years.

It is mutually agreed that in installing, operating, and maintaining the works-of-improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire, with other than PL-566 funds, such land rights as will be needed in connection with the works-of-improvement. (Estimated Cost $14,000).

2. The Sponsoring Local Organization assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services, and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organization and the Service as follows:

	Sponsoring Local Organization (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	48.5	51.5	$0 1/

1/ Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown.

3. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works-of-improvement.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Level Diversions	0	100	$246,800

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Engineering Costs (dollars)
All Structural Measures	0	100	37,000

6. The Sponsoring Local Organization and the Service will each bear the costs of Project Administration which it incurs, estimated to be $2,500 and $37,000 respectively.

7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure, that they will carry out conservation farm or ranch plans on their land.

8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works-of-improvement by actually performing the work, or arranging for such work, in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation or works-of-improvement will be used.

12. This agreement is not a fund-obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the availability of appropriations for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works-of-improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto, except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organization in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties. "An amendment to incorporate changes affecting one specific structural measure may be made by mutual agreement between the Service and the sponsor(s) having specific responsibilities for the particular structural measure involved."

14. No member of or delegate to congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964, as amended, and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any activity receiving federal financial assistance.

16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

Hansel Valley Watershed District

By s/ Rudy Hupp

Title Vice Chairman

329 No. Tremont Street
Tremonton, Utah 84337
Address Zip Code

Date June 18, 1975

The signing of this agreement was authorized by a resolution of the governing body of the Hansel Valley Watershed District

adopted at a meeting held on April 16, 1975

s/ Donald L. Brown
Secretary

Snowville, Utah 84336
Address Zip Code

Date June 18, 1975

Box Elder County

By Don E. Chase /s

Courthouse
Brigham City, Utah 84302
Address Zip Code

Date June 18, 1975

The signing of this agreement was authorized by a resolution of the governing body of Box Elder County

adopted at a meeting held on June 17, 1975

Rella W. Olson
Secretary

County Court House
Brigham City, UT 84302
Address Zip Code

Date June 18, 1975

Northern Utah Soil Conservation District

By s/Dale N. Allen

423 No. Tremont St.
Tremonton, Utah 84337
Address Zip Code

Date June 18, 1975

The signing of this agreement was authorized by a resolution of the governing body of the Northern Utah Soil Conservation District

adopted at a meeting held on June 12, 1975

s/Earl T. Fuhriman
Secretary

573 No. Tremont St., Tremonton, UT
Address Zip Code
84337

Date June 18, 1975

Appropriate and careful consideration has been given to the environmental aspects of this project.

Soil Conservation Service
United States Department of Agriculture

Approved By: s/ A. W. Hamelstrom
State Conservationist

Date June 18, 1975

WATERSHED WORK PLAN

HANSEL VALLEY WATERSHED

Box Elder County, Utah

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended

Prepared by: Hansel Valley Watershed District

Box Elder County

Northern Utah Soil Conservation District

With assistance by;

U.S. Department of Agriculture, Soil Conservation Service

June 1975

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HANSEL VALLEY WATERSHED
BOX ELDER COUNTY, UTAH

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WATERSHED WORK PLAN

HANSEL VALLEY WATERSHED
Box Elder County, Utah

December 1974

SUMMARY OF PLAN

The Hansel Valley Watershed is located in northwestern Utah, in Box Elder County, and is part of the Great Salt Lake Subregion of the Great Basin Region. It contains 76,200 acres of land, of which 72,240 acres are private, 2,000 acres are state, and 1,960 acres are National Land Reserve. The land is being used for growing non-irrigated crops and for range.

There are no towns within the watershed area. Brigham City, county seat of Box Elder County, is located 50 miles southeast via Interstate 80N and Interstate 15. Tremonton is located 30 miles east via Interstate 80N.

The sponsoring local organizations are Hansel Valley Watershed District, Box Elder County, and Northern Utah Soil Conservation District.

The main problems are high soil erosion rates, sediment deposition, and insufficient soil moisture. These result in loss of soil productivity, sediment damage to roads, farmsteads, crop and rangeland, and lack of sufficient moisture to mature crops.

Works of improvement to be installed will include land treatment measures. On the cropland these will consist of on-farm terraces and management practices such as conservation cropping systems including stubble-mulch tillage. Range treatment measures will include proper grazing use, brush management, improved systems of grazing, range seeding, and watering facilities. Structural measures will consist of level diversions and appurtenant structures.

The proposed works of improvement will reduce soil losses caused by erosion approximately 93,700 tons per year. Annual sediment deposition will be reduced approximately 22,500 tons. The improved management of surface residue will increase moisture available for crop use by approximately two inches per year.

Environmental effects include increased vegetation, reduced soil erosion, and improved resource management.

Operation and maintenance of structural measures will be the responsibility of the Hansel Valley Watershed District. Annual operation and maintenance costs are estimated to be $4,940. Operation and maintenance for land treatment measures will be the responsibility of landowner or operator.

The project will be completed during a 10-year period. Total project cost is estimated at $959,400. PL-566 funds will provide $493,800 and $465,600 will be provided from other funds. Total land treatment cost is estimated to be $622,100 of which $173,000 will be from PL-566 funds for accelerated technical assistance and $449,100 are other funds. Estimated total cost of structural measures is $337,300 of which $320,800 are PL-566 funds and $16,500 are other funds. Estimated average annual benefits from structural measures are $100,470 and average annual costs are $25,960. The ratio of benefits to costs is 3.9 to 1.0.

WATERSHED RESOURCES-ENVIRONMENTAL SETTING

PHYSICAL DATA

The Hansel Valley Watershed Project area covers 76,200 acres in north central Box Elder County in northwestern Utah. It is west of and adjacent to Blue Creek-Howell Watershed Project. Approximately 31,000 acres are cropland and the remaining 45,200 acres are rangeland.

Hansel Valley drains directly into the Great Salt Lake. It is part of the Great Salt Lake Subregion, Great Basin Region. There are no towns within the watershed. Early settlers built homes and lived on individual farms. Roads and transportation facilities were poor. Most present landowners live in nearby towns and occupy farm homes within the project area only while carrying out seeding and harvest operations. Two families live within the watershed year-round.

Tremonton, with a population of about 2,800 people, is the nearest major town. It is 30 miles to the southeast on Interstate 80N which traverses the northern part of the project area. Brigham City, Box Elder County seat, has a population of about 14,000. It is located 50 miles southeast on Interstate 80N and 15. The small town of Snowville is located about six miles northwest. In addition to Interstate 80N, some poorly-developed dirt roads provide access into and within the watershed. The Salt Lake-Boise underground gas pipeline traverses the southern part of the watershed. Telephone and electric power service is available on a limited basis.

Elevations range from about 4,200 feet at the south end of the watershed to about 7,000 feet in the north Promontory Mountains which form the east boundary. The Hansel Mountains with an elevation of about 6,300 feet mark the west boundary.

Average annual precipitation ranges from 10 inches in the south to 16 inches in the northern part of the watershed. Monthly distribution is fairly even throughout the year. Short-duration, high-intensity

thunderstorms occur within the watershed annually, but usually cover only a small area. The average growing season is about 86 days. Extreme variations in temperature are characteristic. The temperature ranges from a mean monthly low of 10 degress Fahrenheit in January to a mean monthly high of 89 degrees Fahrenheit in July.

Most of the valley was covered with water during the Lake Bonneville era. The valley floor is undulating and many lake benches and gravel bars are evident.

Major faults occur along both the east and west sides of the valley proper. The fault on the east side, adjacent to the North Promontory Mountains, is prominent and active. The mountainous areas are steep and irregular. The Hansel and North Promontory Mountains are composed mainly of sedimentary and metasedimentary rocks including limestone, sandstone, quartzite and shale. A basalt flow covers part of the north end of the watershed.

The land uses in the watershed are non-irrigated cropland and rangeland. The cultivated area on the lower flatter sloped land is primarily cropped with winter wheat every other year. On alternate years the ground is fallowed to control weeds and store enough moisture from precipitation to produce the wheat crop. The non-cultivated mountainous area is grazed by cattle during the winter and spring. Some sheep also use the area during movement from winter to summer range.

Erosion caused by rainfall and snowmelt runoff occurs throughout the watershed, but is more severe on the 31,000 acres of cropland. In the central part of the watershed, sediment, along with floodwater concentrations, covers low cropland areas and some roads where they cross swales.

The soil patterns are complex because of variations in elevation, precipitation, relief and drainage. Soils in the mountains above Lake Bonneville levels are dominantly shallow or moderately deep over sedimentary and basic igneous rocks. Surfaces are usually cobbly or stony and rock outcrops are common. The soils on the fans and lake terraces are typically gravelly or sandy. Farther out into the valley the soils are loamy and silty. Toward the Great Salt Lake soils are silty clay loams, silty clays and clays commonly affected with water tables, salinity, and alkali.

Soils in the cropland area are principally Hansel, Palisade, Sanpete, and Stingal. These are all deep, well-drained soils and are mainly loamy or silty throughout, except for Sanpete soils which are gravelly or cobbly. Most of the cropland area is on slopes of 0 to 10 percent with some slopes up to 20 percent. Cropland soils are mainly in capability classes and sub-classes IIIe, IVe, and IVs with minor areas in IIIc and IVc.

The Soil Survey Map of Hansel Valley is shown in Figure 2. Description of the soils and their placement in land capability units and range sites is given in the table following the soils map.

The three major range sites in the Hansel Valley Watershed are Upland Loam, Upland Stony Loam, and Upland Shallow Loam (Juniper) comprising approximately 28,900 acres. In addition there are 16,300 acres of Salt Meadow, Mountain Stony Loam, Mountain Loam, Semidesert Alkali Flat, and Semidesert Loam.

Range condition on Upland Loam range site is 35 percent in good condition, 5 percent in fair, and 60 percent in poor condition. Poor condition range has 10 to 20 percent grasses and forbs that are valuable for grazing with 70 to 80 percent low value big sagebrush, annual weeds, and cheatgrass. The remaining vegetation is other grasses, weeds, and brush Good condition range has 40 to 60 percent grasses and forbs dominated by bluebunch wheatgrass and 20 to 30 percent big sagebrush. The remainder is comprised of other grasses, weeds, and brush. At the present rate of improvement with continued proper grazing use, range condition will improve one condition class in 5 to 10 years.

Upland Stony Loam range site is 20 percent in poor condition and 80 percent in fair condition. The vegetative composition of the poor condition range is 75 to 90 percent big sagebrush, annual weeds, and cheatgrass, with about 10 to 15 percent grasses and forbs. The remainder is comprised of various other grasses, weeds, and brush. Big sagebrush with large amounts of annual weeds and cheatgrass dominates 50 to 75 percent of the fair condition range with 25 to 50 percent forbs and grasses, mostly bluebunch wheatgrass. The remaining vegetation is other grasses, weeds, and brush. With proper grazing use this site will improve one condition class in five years or less.

Upland Shallow Loam (Juniper) range site is 70 percent in good condition, 15 percent in fair condition and 15 percent in poor condition. The dominant plant in good condition range is juniper, comprising 25 to 40 percent of the total annual yield with 50 to 65 percent bluebunch wheatgrass, bitterbrush, and black sagebrush. The remaining vegetation is other grasses, weeds, and brush. Fair condition range has 35 to 50 percent juniper, with 20 to 30 percent bluebunch wheatgrass, bitterbrush, and black sagebrush. The remaining vegetation is comprised of various other grasses, weeds, and brush. Poor condition range is usually 50 to 70 percent juniper, with 5 to 15 percent bluebunch wheatgrass, bitterbrush, and black sagebrush. The remaining vegetation is comprised of various other grasses, weeds, and brush. At the present trend, and with proper grazing use, the good condition range will improve to excellent in three to five years. The fair and poor condition areas will need to be chained to improve forage condition and control erosion. The poor condition areas should be seeded.

The principal ground water reservoir is in the unconsolidated and semi-consolidated sediments of Tertiary and Quaternary Ages and in consolidated rocks of the Paleozoic Age. Average annual ground water recharge and discharge are in balance and are estimated to be 11,000 acre-feet each. Recharge is derived from precipitation within the Hansel Valley Drainage. Ground water is discharged from Hansel Valley by evapotranspiration, subsurface outflow, and unconsumed spring discharge.

About 13,000 acres in the northern part of the valley are underlain by ground water suitable for irrigation. The chemical quality is classified slightly saline having a dissolved solid concentration less than 1,000 milligrams per liter. A low sodium hazard makes it suitable for irrigation. An estimated 65,000 acre-feet of water could be recovered from the upper 100 feet of the ground water reservoir. 1/ Recharge values are unknown.

Watershed drainages are ephemeral, in well-defined natural channels. There are two main drainages in the north, or upper end of the watershed. These join in the central part of the watershed and continue south to the Great Salt Lake. They are generally sagebrush covered on the steep sides, gullied in the bottom where channel gradients are steep and farmed in the bottom where the channel gradients are flat.

Salt Wells springs are located at the extreme south end of the watershed and provide the only year round supply of water for waterfowl, upland game, deer, and other game and nongame animals. Salt Wells springs are also used for livestock water. The dissolved solids concentration of Salt Wells springs is about 4,000 milligrams per liter, the chemical quality classification is saline. It has a very high salinity and sodium hazard for irrigation. Most of this saline water enters the watershed drainage channel and flows into the Great Salt Lake. These springs supply water to 2,270 acres of Type 11, Inland Open Saline Water and Type 9, Inland Saline Flats, as defined in Wetlands of the United States, Department of the Interior, Fish and Wildlife Circular 39. The sparse vegetation of Type 9, Inland Saline Flats, consists of salt tolerant plants such as saltgrass, alkali bulrush, salicornis and greasewood. The Type 11 wetlands are shallow, primarily open waters containing sago pondweed and wigdeongrass surrounded by alkali, Olney's, and hardstem bulrushes. These areas extend approximately eight miles south of the watershed to the Great Salt Lake.

ECONOMIC DATA

There are 34 farm and ranch units operating within the watershed. These are cropland and mixed cropland-rangeland units. Units range in size from 320 acres to 24,000 acres. Most of the operators also have holdings in nearby valleys. Of the 76,200 acres in the project area, about 31,000 acres are cropland and 45,200 acres are rangeland. One individual operates a commercial upland game bird hunting preserve in conjunction with his regular farming operation. The amount of land occupied by roads and homesteads is negligible.

Presently 2,000 acres are state lands, 1,960 are National Land Reserve, administrated by the Bureau of Land Management and 72,240 acres are private lands. Public lands are scattered throughout the range areas, leased to adjoining landowners, and used primarily for grazing.

1/ Underground water information is published in STATE OF UTAH DEPARTMENT OF NATURAL RESOURCES Technical publication No. 33.

Crops grown are wheat and alfalfa. The wheat growing area represents about 90 percent of the cropland. It is cropped only every other year because of lack of moisture. Present wheat yields average 20 bushels per acre per crop and alfalfa yields range from one to two tons per acre. Some of the cropland area is also used for livestock winter range after harvest until April or May. Land values vary from $150 to $200 per acre for non-irrigated cropland and from $15 to $25 per acre for rangeland.

The principal markets for the grain grown in the watershed are in Tremonton or Brigham City, distances of 30 miles and 50 miles respectively. These markets are reached by truck on Interstate 80N which traverses the northern tip of the watershed and is the main access route. Access within the watershed is also available on poorly-developed dirt roads in the southern part of the area.

The geographic location and lack of utilities discourage permanent residence in the watershed, although most operators are full-time farmers managing family farms. The general economy of the area is dependent on long-term climatic conditions which affect crop yields and on prices received for livestock and grain. Employment in the area is limited to occupations related to the farm and ranch operations. Most farmers receive adequate income only by operating additional farms in other areas. The gross income of the farm operators and owners is:

Income Class	Percent of Operators in Class
Less than $10,000	25
$10,000 to $30,000	50
More than $30,000	25

FISH AND WILDLIFE RESOURCES

Upland game bird densities in the cropland areas are low to negligible because of a lack of suitable habitat. Upland game birds and mammals present throughout the watershed include sage grouse, chukar, pheasant, Hungarian partridge, mourning doves, cottontails and jack rabbits. Population levels for most species, with the possible exception of mourning doves and rabbits, are generally low. Most species are found along the boundaries between rangeland and cropland where there is both food and cover.

Cultivation and cropping systems remove most of the wildlife cover and food on the 31,000 acres of cropland. Grain is the primary crop, but it is all harvested and the straw placed in stacks for livestock feed. Some waste grain is left on the ground after harvesting, but becomes unavailable when covered by snow.

The general condition of the rangelands surrounding the valley ranges from poor to good with most sites dominated by sagebrush. While supplying cover, solid stands of sagebrush do not provide the variety and abundance of grasses, forbs, and shrubs necessary to meet year-round food requirements for upland game and other wildlife.

Year-round wildlife drinking water is in short supply. Drinking water is available only near farmsteads and at Salt Wells springs.

Big game species present are antelope and mule deer. Deer are found on sagebrush and pinyon-juniper mountain slopes on the east and west sides of the valley. Antelope occupy the southwest portion of the watershed. Neither species is present in appreciable numbers. The deer populations increase during the winter because of migration from surrounding areas of high elevation where the winters are more severe.

Habitat for waterfowl is limited because of a lack of open water and marshlands. Salt Wells springs, although small in area compared to the total watershed area, provide good waterfowl habitat. Grain left on the ground after harvesting provides some food for migrating waterfowl, primarily geese. These birds spend most of the day on marshlands around the Great Salt Lake and make evening and morning flights in search of food. Most waterfowl migrate out of the area after the first hard freeze, usually around the first of December.

The only fish within the watershed area are found in Salt Wells springs. Although not sampled, the fish population is assumed to be primarily non-game species such as chubs and dace.

Non-game species present include such animals as coyotes, badgers, hawks, owls, small rodents and song birds. Prey populations are limited by the lack of food and cover in the cultivated areas and predator population's are limited by the resultant lack of prey species. Populations of most animals are larger in rangeland areas.

RECREATIONAL RESOURCES

The "Appraisal of Potentials for outdoor Recreation Developments in Box Elder County, Utah," prepared in December 1968, was used as an evaluation guide. The overall potential for recreation development is low to medium. The potential for hunting areas in Box Elder rates high. Public hunting in Hansel Valley is presently not being utilized because of trespass restrictions. Most types of recreation developments are restricted because of an inadequate supply of water and because of the remoteness of the area. The soils, scenery, and climate are not significantly different from areas closer to population centers.

A private hunting preserve is located in the southeast corner of the valley. Pen-reared pheasants and chukars are released for hunters patronizing the preserve.

ARCHEOLOGICAL AND HISTORICAL VALUES AND UNIQUE SCENIC AREAS

The only known archeological, historical or unique scenic areas in the watershed are lake terraces and similar features formed by prehistoric Lake Bonneville. Several miles south of the watershed is the Great Salt Lake which is a remnant of prehistoric Lake Bonneville. The transcontinental railroad grade runs along the alkali flat between the watershed and the Great Salt Lake.

The preservation Planning Director for the State of Utah in the Division of State History was contacted. He indicated there was nothing within Hansel Valley that is of historic value.

The State of Utah Archeologist was contacted. He indicated there was not any known archeological sites present in Hansel Valley, but there may be unknown sites present. The installation of structural measures in areas presently being farmed should cause no further damage to archeological sites within those areas. The installation of the diversions, the only structural measures planned in the areas not presently being farmed, may damage unknown archeological sites.

The specific locations of these diversions will not be known until the initial on-the-ground layout is made prior to installation. At this time a professional archeologist will make a field examination of the areas where diversions will be crossing undisturbed lands. The diversions will be realigned or modified to preserve any archeological sites or the artifacts will be recovered. Any archeological resources that are noted during construction will be reported to the National Park Service and the Utah State Archeologist.

SOIL, WATER AND PLANT MANAGEMENT STATUS

Land treatment on cropland necessary to keep soil loss within acceptable standards is generally not being practiced. Of the 34 operators, 24 are cooperators with the Northern Utah Soil Conservation District. Resource conservation plans have been developed for 18 of the units, but 11 of these need revision to reflect current concepts of soil stabilization. The 24 district cooperators control 93 percent of the land.

Crop residue and tillage management systems is practiced on 9,300 acres or 30 percent of the cropland. Terrace system installation is needed for adequate treatment. Adequate treatment has been planned on 18,600 acres or 60 percent of the cropland.

Proper grazing use has been planned on 80 percent of the rangeland. Sixty percent of the rangeland is being properly used to maintain or improve protective vegetative cover.

In summary: adequate land treatment, except for terrace installation, exists on 36,400 acres of the watershed area; adequate treatment has been planned on 54,600 acres of about 72 percent of the area.

WATER AND RELATED LAND RESOURCE PROBLEMS

LAND TREATMENT

The Hansel Valley Watershed has experienced excessive sheet erosion in the past. This erosion has removed fertile topsoil causing average annual production to reduce. Because the production has gone down, adequate crop residue is not available to design good crop residue and tillage management systems to control the sheet erosion.

Rill and gully erosion are also becoming major problems in hansel Valley. Runoff water starts to concentrate a certain distance down slope. Crop residue and tillage management has not been successful in controlling erosion where water starts to concentrate. At this location, management practices must have the support of a terrace. This situation exists all the wat down long slopes and several landowners are usually involved. Group cooperation is necessary to install needed land treatment in a logical sequence to provide maximum control of the runoff.

Because landowners are not able to keep erosion rates below the allowable maximum, an accelerated program to reverse the trend of decreasing production is needed as soon as possible. A cooperative effort by the entire watershed group is necessary to solve sheet, rill and gully erosion problems.

FLOODWATER

Floodwater damage includes swamping of low cropland areas, gullying where floodwaters accumulate, movement of topsoil and nutrients, and interruption of and potential hazard to traffic during flood periods. This results in reduced crop yields, excessive equipment wear during farming operations, reduced income through inability to harvest some areas, and increased road maintenance costs.

Runoff from cropland generally occurs every year. Normally it occurs throughout the watershed; however, it may be only from isolated areas. The runoff period is normally during spring snowmelt. The large infrequent floods which cause excessive damage usually result in a complete change in land pattern in areas of water concentration. Roads e regraded and some of them relocated.

EROSION

Erosion occurs as a result of runoff from snowmelt, rain on snow, and summer rain. Erosion is most prominent on croplands; however, erosion occurs on rangelands during high-intensity, summer cloudburst storms. Approximately 150,000 tons of soil are eroded from cropland annually and about 2,000 tons from rangeland, occuring as sheet and rill erosion. Roadside erosion is estimated at 3,000 tons annually. Gully erosion on cropland and rangeland is estimated at 26,800 tons annually.

Generally, the central part of the watershed shows more signs of erosion, especially on the west-and southwest-facing slopes. This area of the watershed is more severely eroded because of long slopes, fine-textured soils, and scant vegetative cover. Land with this combination of characteristics has a tendency to erode severely during the prolonged runoff of snowmelt.

Gullies enlarged by widening and headcutting have destroyed approximately 130 acres of cropland during the past 50 years. Smaller gullies and rills have created rough and untillable land. Approximately 8,920 acres of rough and 760 acres of untillable land have developed during the last 40 years. Land affected by numerous gullies exceeding 5.0 square feet in cross-sectional area is classified as untillable. Land affected by numerous gullies with cross-sectional area ranging from 1.5 to 5.0 square feet is classified as rough land.

Annual damage projected to a future "without project" condition is $94,170. Of this amount $71,910 is from sheet erosion and $22,260 is from gully erosion.

If erosion is left uncontrolled and technology advances as it has in the past, the average yield of grain will increase an additional five bushels per acre within 50 years. This yield increase is much less than could be realized with controlled erosion.

SEDIMENT

Sediment deposition damages crops, roads, farmsteads, and fences. Excessive sediment deposition on cropland during the growing season results in almost complete loss of crops. It is estimated that under future conditions without a project, annual sedimentation damage will have increased an additional five percent within 50 years. Most sediment reaching drainageways is transported out of the watershed and deposited in the Great Salt Lake.

There is considerable deterioration of water quality because of sediment and organic matter transported in the intermittent flows. At the present time, no use is made of watershed runoff. Present average annual sediment yield at the lower end of the watershed is estimated to be 26,900 tons. The average annual runoff has an average sediment concentration of 20,000 ppm. Waterfowl habitat in Salt Wells springs and marsh areas is being damaged by sediment deposition.

Sediment deposition on roads interrupts traffic until the sediment is removed, resulting in inconvenience to landowners getting to and from their farms. Annual damage from sediment deposition is estimated to be $6,680.

RECREATION

At present, there does not appear to be any demand for major recreation developments. Limited culinary water, excessive distance from population centers, lack of unique or atrikingly different land formations, and absence of historical or archeological features limit the potential for development.

WILDLIFE

Wildlife populations are limited by a general lack of habitat. The scarcity of perennial streams, springs, lakes, or ponds, the absence of a winter food supply and year-round cover, are key factors resulting in the low production and survival of wildlife.

ECONOMIC AND SOCIAL

Most land operators in the watershed are full-time farmers and need their entire unit to maintain an economical operation. Farm income is adequate, but the gradual decrease in crop yield potential resulting from erosion could make continued farming uneconomical. The income level is above state and county averages. This is due primarily to large scale operations.

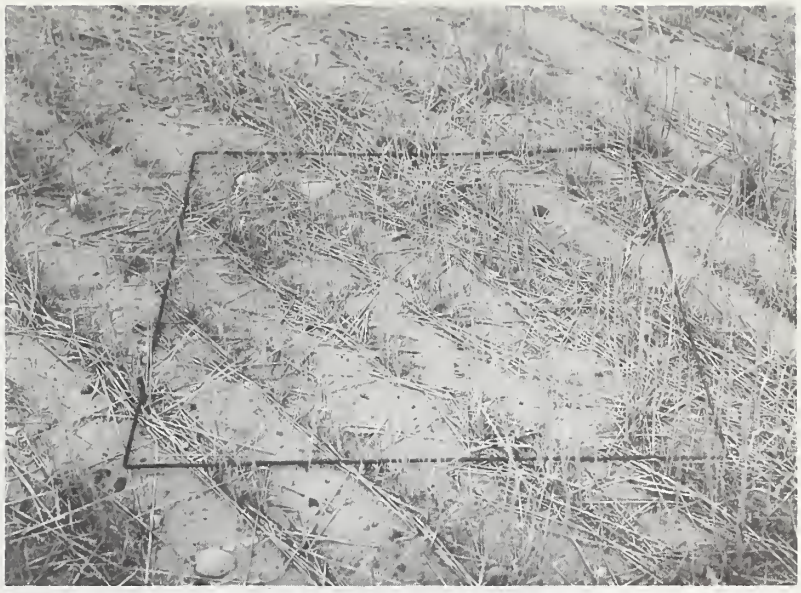
PLATE 1

Rill and gully erosion on a long unbroken field slope. Terracing which breaks up the slope, along with crop residue management and cross slope farming are needed to reduce erosion damage.

SCS PHOTO U-766-2

Erosion damage on a short field slope without the protection of crop residue management, cross slope farming and terraces. Tillage ridges running up and down the slope provide channels for runoff water to concentrate and cause erosion.

SCS PHOTO U-701-6



1-1 Standing stubble, 1,000 pounds per acre, after grain harvest. SCS PHOTO U-590-6

The amount and degree of erosion damage can be greatly influenced by the residue management practices being carried out.

Photo series 1-1, 1-2, 1-3 demonstrates the effects of erosion on areas with less than 1,000 pounds of residues on and above the soil surface. Where less than 1,000 pounds per acre of standing stubble is available after grain harvest (shown in Photo 1-1) the land cannot be adequately protected from rainfall erosion by a residue management system.

1-2 Standing stubble, 1,000 pounds per acre, appearance after damaging rainstorm. SCS PHOTO U-701-8

1-3 Plowed, leaving 200 pounds per acre of residue on surface, appearance after damaging rainstorm. SCS PHOTO U-701-10

PLATE 3

SCS PHOTO U-1212-13

Sediment deposition damage on a county road. Runoff water concentrating in watercourses causes flooding, gully erosion and deposits sediment on fields and roads.

SCS PHOTO U-720-1

Erosion damage in a cropped watercourse of a large drainage. Water concentrates in large quantities where crop residue management and terrace systems do not reduce the runoff. Level diversions and terraces are needed to prevent the concentration of runoff water by trapping and allowing it to infiltrate into the soil.

PLATE 4

SCS PHOTO U-1540-3

Floodwaters interrupt rural traffic by flooding, eroding, and depositing sediment on the rural roads in the watershed.

SCS PHOTO U-757-18

Gully erosion is unsightly in the landscape, encourages deposits of trash and other debris, and results in unsafe conditions for traffic at road crossings.

SCS PHOTO U-1428-5

Most farmers utilize family labor. Hired labor is used on limited occasions for associated livestock enterprises.

WATER QUALITY

The chemical quality of surface and ground water in Hansel Valley discourages potential development. The concentration of dissolved solids in water samples ranged from 400 to 19,000 ppm. The ground water is slightly saline to briny and has a high salinity hazard for irrigation. Less than 20 percent of the valley will yield ground water suitable for irrigating salt-tolerant crops. About half the area yields ground water suitable for livestock and wildlife, and only a small volume of water at the base of the North Promotory Mountains is suitable for culinary use. Agricultural use of water in Hansel Valley is mainly for livestock.

PROJECTS OF OTHER AGENCIES

No known water resource development projects of other agencies are planned that are related to project works of improvement.

PROJECT FORMULATION

The landowners within the Hansel Valley Watershed were familiar with activities in the adjacent Blue Creek-Howell Watershed. The construction which started in 1961, was designed to provide conveyance control of the runoff. Runoff continued to cause cropland erosion and gully erosion, damaging the water conveyance structures. About five years after construction started, the objective in the Blue Creek-Howell Watershed was changed to provide on site detention and storage of the runoff from cultivated land. The success of this program encouraged the Hansel Valley landowners to inquire about terrace systems.

In an effort to assist individual landowners with the on-site water-storage concept, it was determined that group cooperation was necessary to provide protection to the watershed. The Soil Conservation Service suggested that Hansel Valley landowners set up a representing body and make a watershed application. The application was made in March 1969.

A watershed committee was set up and proved to be very capable and active in their efforts to provide information to landowners, sponsors, organizations, and the general public. They also obtained input from interested organizations and agencies for various aspects of this plan.

Committee meetings were held almost every month. The landowners and sponsors were invited to attend, as were federal and state agencies. Representatives from Farmers Home Administration, Agricultural Stabilization and Conservation Service, Box Elder County Commission, State Division of Wildlife Resources, and Soil Conservation Service were present at most of the meetings. Several open public meetings were held to present views and discuss impacts of proposed project measures on wildlife resources, public and private property within the watershed and

were sent to all federal, state and local agencies interested in the project and all sponsors and landowners. The notices were also published in the local paper.

Most of the meetings were called to discuss specific planning problems. However, opportunity to discuss issues of any type was open at each meeting. Inputs were requested by letter from agencies and organizations that did not attend the meetings such as United States Fish and Wildlife Service, Utah State Historical Society, National Park Service Archeological Center, and the University of Utah Department of Anthropology.

OBJECTIVE

The primary objective of this project is two-fold; (1) to reduce floodwater runoff and soil erosion; (2) to insure continued present land use and sustain proper use of the land resources.

The landowners plan to increase available moisture for crop production by reducing the average on-site runoff of the annual precipitation by about two inches. They will also reduce soil losses to amounts allowable for various soils, which range from one to five tons per acre per year. Meeting these objectives will enable the landowners to continually use the land resource properly.

These objectives will be achieved by installing land treatment measures, including terraces designed to control a ten-year frequency runoff event, and structural measures to intercept and contain the 25-year, 5-day, rain and snowmelt runoff from non-farmed areas and farmed areas too steep to terrace.

ENVIRONMENT CONSIDERATIONS

In the formulation of the alternatives for solving watershed problems, the following environmental considerations were evaluated:

1. At present, sheet and rill erosion results in a total soil loss from cropland of about 150,000 tons per year. Allowable soil loss from 31,000 acres is about 100,000 tons per year. The loss of the topsoil results in decreased crop productivity and degrades water quality. Eighteen hundred tons of sediment are deposited annually in the Great Salt Lake and on wetlands adjacent to the Lake.

2. Because of fire control practices and past over-use by livestock, the amount of big sagebrush has increased from 10 to 15 percent to 50 to 75 percent on many sites and as high as 90 percent on some sites. This increase in the amount of big sagebrush has been accompanied by proportionate decreases in grasses and forbs.

3. The lack of plant diversity on sagebrush-dominated sites causes increased runoff and accelerated erosion and does not provide the necessary plant diversity and interspersion required by all forms of wildlife.

4. There are about 10,000 acres of unnatural, shrub-dominated sites that require conversion to a more diversified climax-type shrub, forb, and grass ecosystem.

5. The lack of plant diversity on 31,000 acres of cropland and 10,000 acres of rangeland, coupled with a lack of well distributed drinking water, are major factors limiting wildlife populations. There is a need to intersperse cropland areas with upland game and wildlife watering areas. Rangeland areas can be improved for all forms of wildlife by improving plant diversity and creatiadditional wildlife watering areas.

6. Project measures will not require any displacement of people or farm operations.

ALTERNATIVES

Five alternatives were considered to reduce floodwater runoff and soil erosion on cropland. Only one treatment was considered for protecting and improving rangeland. The treatment consists of range seeding, brush management, proper grazing use, including planned grazing systems and water development. Floodwater, erosion, and effects to wildlife habitat were considered in determining the quantity of treatment to be installed.

Alternative I

This alternative considered an accelerated land treatment program without terraces or diversions. This program stresses the adoption of crop residue and tillage management systems that maximize protection to the land surface. It includes adjustments of crop rotations and the seeding of some lands to permanent vegetative cover. The program would offer technical and financial assistance in addition to present programs over a five-to ten-year period to landowners and operators who will adopt acceptable management systems.

Sheet and rill erosion reduction objectives can be met by following a winter wheat-fallow cropping system on approximately 10,000 acres with slope gradients up to 3 percent. A stubble-mulch tillage system that would leave a minimum of 1,200 pounds of straw residue on the soil surface after drilling winter wheat is essential.

A cropping adjustment is essential on 15,000 acres with slope gradients of 3 to 7 percent. The cropping system would be adjusted placing emphasis on strip cropping (permanent cover in alternate strips with winter wheat and/or fallow). Stubble-mulch tillage would also be necessary.

A cropping adjustment is essential on 5,000 acres with slope gradients of 7 to 14 percent. Lands in this category would be converted to hay or pasture use. This system would require the installation of additional fences and water developments to meet pasture management objectives, and provide a stable resource base for wildlife. Fences and water development would not be required for management as hay land.

The adoption of this program would require some landowners to change their farming enterprise to a livestock-oriented operation.

The cost of implementation of this program would be approximately $103,000. It would have a favorable impact on the environment by improving habitat for wildlife, reducing erosion, and preventing unsightly eroded areas.

Alternative II

This alternative considered cropland treatment consisting of crop residue and tillage management systems, crop rotation adjustments, cross slope farming, and terrace systems. Structural measures consisting of level diversions at the top of cropped areas to protect terraces from floodwater originating on rangeland and cropped areas to steep or irregular to terrace. Level diversions were planned at every sixth terrace space to provide 25-year protection vs. 10-year for land treatment. The diversions would store the volume of runoff expected from a 25-year 5-day rain and snowmelt on frozen ground. Terraces would store this runoff on a 10-year frequency.

This alternative will also reduce land treatment maintenance needs and lower the frequency and magnitude of gully erosion within and below the cropland area. The cost of implementing this alternative would be approximately $1,376,000. The impacts on the environment would be the same as Alternative I. In addition the landscape pattern would change from block farming to contour farming, showing level structures throughout the cropland area.

Alternative III

This alternative is the same as Alternative II except for the diversions at every sixth terrace space were replaced with a series of combination floodwater-retarding, debris-storage, and grade stabilization structures. This alternative would provide the same protection as Alternative II with the added protection of erosion control and grade stabilization in the main drainage channels. Sediment damage to the Salt Wells springs area and adjacent saline wetlands would be reduced, thus improving waterfowl habitat.

The cost of implementing this alternative would be approximately $1,384,000. The impacts on the environment would be the same as Alternative II except that waterfowl habitat would improve. Some wildlife habitat would be destroyed in the main drainage channels at the location of the storage basins.

Alternative IV

This alternative is a "without project" situation. It consists only of the going land treatment program consisting of a conservation cropping system, including crop residue management, minimum tillage, cross slope farming, and terraces on only part of the cropland. No structural measures or accelerated land treatment programs would be installed. This alternative would not reverse the trend of soil loss, sediment deposition, gully pattern development, or other existing and

projected damage. A few individuals would benefit from their own land treatment programs, but would not be protected from runoff originating on rangeland and unprotected cropland above. Going program costs are approximately $26,000 for 10 years. There would be no change in impacts on the environment.

Alternative Selected

The combination of land treatment and structural measures selected for installation is economically feasible and physically practical and will reduce floodwater runoff and consequent soil erosion to the values permissible on a majority of the soils. Floodwaters in channels will be reduced, consequently slowing down channel erosion. There will be some active gully erosion in the main drainage channels serving as outlets which cannot be economically stabilized.

This alternative will also provide continued present land use and the opportunity to sustain proper use of the land resources.

All combination floodwater-retarding, debris-storage, and grade stabilization structures in the main drainage channels and all level diversions interspersed in the cropland terraces below the top line diversion were economically infeasible.

WORKS OF IMPROVEMENT TO BE INSTALLED

The project measures to be installed are those that will reduce floodwater runoff and erosion. The project will consist of both structural and land treatment measures.

The works of improvement includes rangeland treatment, floodwater control structures and terraces to reduce soil loss from sheet and rill erosion. Proper land use will also be practiced to assure continued resource protection.

LAND TREATMENT MEASURES

Land treatment measures on cropland will consist of level on-farm terraces to control erosion and conservation cropping systems with major emphasis directed toward stubble-mulch tillage and cross slope farming.

Range treatment will include proper grazing use and planned grazing systems, range seeding, and brush management, including juniper chaining. Livestock watering facilities will be developed.

Technical assistance will be furnished for planning and installation of land treatment measures on cropland and rangeland, and for preparation of resource conservation plans.

STRUCTURAL MEASURES

Structural measures to be installed consist of level diversions and appurtenant structures to supplement the land treatment measures in protecting cropland from excessive runoff and erosion.

The level diversions planned have a combined length of approximately 60 miles, located to protect almost all cropland in the watershed from runoff originating on the steep rangeland. The diversions will essentially form a barrier around the watershed between range and cropland. Approximately 13 of these diversions will require grade-stabilization measures where they outlet into a natural watercourse. Diversion outlet stabilization may consist of a grouted rock riprap chute and stilling apron (details are shown in figure 1). Diversions will be constructed on the contour and consist of a borrow area and an embankment. The borrow area will form a storage channel on the uphill side of the embankment. The elevation difference between the top of the dike and the bottom of the channel will range from 2.5 feet to 8.0 feet with an average of 4.5 feet. All side slopes of the channel and embankment will be 12 feet or more in length and no steeper than four to one to accomodate small farm equipment. Typical detail is shown in figure 1.

The level diversion storage capacity will be designed to contain the runoff from the drainage area above the structure which will occur during a 25-year, 5-day rain on snow with a frozen ground situation.

The design capacity is based on embankment and excavation volumes being equal. Additional capacity for sediment storage is provided by the over-excavation required to compensate for compaction shrinkage, and in basins formed where gullies are crossed with a straightened alignment. This capacity is estimated to be sufficient for two years of average anticipated sediment accumulation. The sediment material will be used periodically to maintain the diversion embankment height and cross section. Consequently, the life of these structures will be prolonged indefinitely, utilizing sediment deposits to repair damage caused by lowering of the ridge top during tillage operations and damage by floodwater overtopping the ridge during infrequent runoff events.

Grass will be seeded on some areas that are disturbed by diversion construction. Such areas include those around diversion outlets, across deep swales where the embankment is not constructed to be farmable, and where the diversions cross rangeland.

Land rights will be needed on 550 acres. This will permit construction, operation, and maintenance of the diversions. Land occupied by diversions will continue to be used for agricultural purposes consistent with the use of the adjacent area, provided such use is not detrimental to the proper functioning of the structures. Diversions may need to cross county roads. The diversion cross sections at these locations will be constructed to permit proper functioning of both diversions and roads.

Elapsed time from start of construction to finish grading of any given section of a structure is only a few hours. Structure surfaces during this period will be rough, which will provide protection from erosion. Upon completion of construction, the structure surface will be graded smooth and be devoid of plant residue. Roughening of the surface as soon as possible after finish grading will reduce the erosion potential.

In the watershed there are no known historical sites listed in the National Register of Historic Places. The State of Utah Archeologist was contacted. He indicated there are not any known archeological specimens in the area, but there may be unknown sites on non-farmed land. These locations will be examined prior to installation by a professional archeologist. Preservation will be accomplished prior to construction. Archeological finds discovered during construction will be reported to the National Park Service Archeological Center and the State Archeologist in the Department of Development Services.

The Soil Conservation Service has complied with Section 106 of PL 89-665 and will comply with PL 86-523 (as amended by PL 93-291), the Archeological and Historical Preservation Act. As a federal assisted local project, the proposed project will not change the existing responsibility of any federal agency under EO 11593 with respect to archeological and historical resources.

2-1 Standing stubble, 3,000 pounds per acre, after grain harvest. SCS PHOTO U-590-8

2-2 Standing stubble, 2,000 pounds per acre, appearance after rainstorm that caused damage on areas with less residue. SCS PHOTO U-590-4

Photo series 2-1, 2-2, and 2-3 demonstrate the value of residue to protect against erosion on areas with 1,600 to 3,000 pounds of residues on and above the soil surface. The objective of the residue management system is to maintain as much of the residue as possible on and above the soil surface by the use of subsurface tillage or no till systems.

2-3 Tilled area with 1,600 pounds per acre of residue on surface, appearance after rainstorm that caused damage on areas with less residue. SCS PHOTO U-828-11

PLATE 6

Terrace systems on cropland. Terraces break up the slope length and store surface runoff preventing the concentration of water and the resulting rill and gully erosion. Terraces encourage cross slope farming which is necessary to help reduce erosion. A diversion above the terraces may be needed to intercept runoff from above to prevent overloading of the terrace system.

SCS PHOTO U-1676-6

Cross slope farming and crop residue management helps to slow down water movement reducing sheet and rill erosion. Note how soil has moved only a foot or two before being trapped by tillage ridges and crop residue.

SCS PHOTO U-1466-4

PLATE 7

SCS PHOTO U-1501-11

SCS PHOTO U-1500-11

Water storage lagoons are created in level terraces and diversions by the partial blocks that are installed to prevent complete drainage in event of a failure. The water can be used by wildlife while it infiltrates into the soil for plant use instead of running off causing rill and gully erosion. Note in the photo on the upper right, with good vegetative cover, very little erosion is evident above the diversion. Compare it with the photo on upper left with summer fallow above the diversion.

Properly constructed terraces do not take cropland out of production but they do stop gullying that can take land out of production. They also encourage cross slope farming.

SCS PHOTO

EXPLANATION OF INSTALLATION COSTS

LAND TREATMENT MEASURES

Installation costs estimates for land treatment measures on private lands include all costs to individual owners and operators. Technical assistance, in addition to that available through going-programs, is needed to plan and apply land treatment measures. PL-566 funds will be used only for the accelerated technical assistance.

The cost for terraces to be installed on cropland is estimated to be $362,600. Installation of land treatment on rangeland will cost $40,000 for brush management and $40,000 for range seeding.

Technical assistance provided by the Soil Conservation Service for installation of terraces will cost $163,860. The amount from PL-566 funds is $162,600 with $1,260 from going-program funds. Technical assistance for rangeland treatment will cost $3,840. The amount from PL-566 funds is $2,700 with $1,140 from going-program funds.

Technical assistance for the installation and implementation of management type land treatment measures on cropland will cost $6,200. PL-566 funds will provide $4,200 and $2,000 from other funds.

Technical assistance for farm and ranch planning will cost $5,600. Accelerated planning amounting to $3,500 will be paid by PL-566 funds. Planning under the going-program will cost $2,100.

STRUCTURAL MEASURES

The values shown in Tables 1 and 2 include all costs for installation of structural measures. Installation costs include construction, engineering services, project administration, and land-rights acquisition.

Total installation cost for approximately 60 miles of diversions and appurtenant structures is estimated to be $337,300. Included in this total are costs as follows: construction $246,800; engineering services $37,000; easements and rights-of-way $14,000; project administration from PL-566 funds $37,000; and project administration from other funds $2,500.

Construction costs will be the lowest acceptable bid for installation of structural measures including, mobilization to the site, preparation of bid, use of equipment, labor costs, cost of materials except the earthfill, overhead, profit, etc. Engineering-services costs include the direct cost of engineers and other technicians for survery, design, and preparation of plans and specification for structural measures. Land-rights include values for lands obtained by easements and costs of preparation and review of easements or rights-of-way, legal fees required to acquire land rights, and road-crossing construction costs.

Project administration costs from PL-566 funds include review of engineering plans prepared by others, government representatives, construction surveys, inspection service during construction, and administration and overhead. Project-administration costs from other funds include administration of contracts, overhead, and inspection furnished by the sponsors.

COST SHARING

Total project costs are estimated to be $959,400. PL-566 funds will provide an estimated $493,800. Other funds will provide an estimated $465,600.

Costs are shared between PL-566 funds in accordance with the provisions of PL-566 , 83d Congress, 68 Stat. 666 as amended, and the policy statement of the Secretary of Agriculture. Diversions and appurtenant structures are single purpose and installation costs are allocated to flood prevention.

PL-566 funds provide all construction costs allocated to flood prevention and all engineering-service costs. Other funds provide land rights costs and project administration furnished by the sponsors.

The following costs will be from PL-566 funds:

1. Cost of accelerated technical assistance for land treatment on private lands, estimated to be $173,000.

2. Total cost for construction of level diversions and appurtenant structures, estimated to be $246,800.

3. Cost of engineering services, estimated to be $37,000.

4. Cost of project administration incurred by the Service for installation of structural measures, estimated to be $37,000.

The following costs will be from other funds:

1. Cost for installation of land treatment measures on private land, estimated to be $442,600. Cost sharing assistance available at the time of installation under other programs for eligible measures will be utilized.

2. Cost of technical assistance for on-going land treatment measures on private land, estimated to be $6,500.

3. Cost of land rights for structural measures, estimated to be $14,000.

4. Cost of sponsors project administration, estimated to be $2,500.

SCHEDULE FOR EXPENDITURE OF FUNDS

Year Work Plan Schedule	Structural Measures			Land Treatment				Total Project
				Technical Assistance				
	PL-566	Other	Total	PL-566 Accelerated	Other Going	Installation	Total	
1	18,500	7,000	25,500	18,400	850	50,760	70,010	95,510
2	70,950	630	71,580	18,400	670	50,760	69,830	141,410
3	89,450	7,630	97,080	18,400	850	50,760	70,010	167,090
4	70,950	620	71,570	18,400	670	50,760	69,830	141,400
5	70,950	620	71,570	18,400	960	50,660	70,020	141,590
6	0	0	0	16,200	500	37,780	54,480	54,480
7	0	0	0	16,200	500	37,780	54,480	54,480
8	0	0	0	16,200	500	37,780	54,480	54,480
9	0	0	0	16,200	500	37,780	54,480	54,480
10	0	0	0	16,200	500	37,780	54,480	54,480

EFFECTS OF WORKS OF IMPROVEMENT

The combined effects of planned treatment and structural measures will reduce erosion and surface water runoff and benefit all 31,000 acres of cropland and 36,000 acres of rangeland. The structural measures will benefit all 34 farms and ranch units in the watershed on 29,100 acres of cropland. This will provide a nucleus for organized development of the total resource. The project will stimulate pride and a cooperative effort by farmers to achieve a higher level of conservation farming and total resource management.

All planned works of improvement produce a combined impact on the watershed. Erosion reduction will decrease costs of equipment operation and maintenance caused by crossing rills and gullies. The future "without project" crop yield of 25 bushels per acre (5 bushels increase from present yield resulting from technological advancements) will increase to 35 bushels of wheat per acre by retaining more water on the land and by conserving the fertile topsoil. The increase will range from one bushel on flat slopes to 18 bushels on steeper slopes. Improved management of surface residue will increase moisture available for crop use approximately two inches per year.

Terraces installed on cropland in sequence from the top of the drainage will reduce the average annual floodwater and sediment damage on the lower areas. The 10-percent-chance runoff of approximately 1,550 acre feet from cropland, will be reduced about 1,300 acre feet by terrace storage. Some flooding of lower cropland areas is still expected during more intense, less frequent storms.

Project measures are expected to have beneficial effects on eroding channels and gullies because of reduced runoff peaks and volumes. Sediment yields from cropland will be reduced considerably, however, onsite runoff will continue to transport significant amounts of suspended load and bed material to downstream drainage systems. Scouring of existing channel deposits and sloughing of channel banks will also contribute sediment to the runoff as it collects in the main drainages.

Therefore, moderate sedimentation will continue in the watershed and along the shore of the Great Salt Lake. Sedimentation damage along the shore of the Great Salt Lake is insignificant at the present time.

Concentration of runoff in natural drainage ways at the diversion outlets may cause some additional erosion in the channel during storms of high intensity. The diversions are constructed with partial blocks at intervals to insure against complete drainage of the structure through the outlet eliminating flow during low intensity storms. These partial blocks will limit possible damage down the cropland slope in the event of a failure due to embankment overtopping.

If the present trend continues, erosion rates will increase about five percent during the next 50 years. With project measures installed, erosion rates will decrease about 60 percent.

Sediment deposition within the watershed will be reduced approximately 5,600 tons per year. This reduction will be from roads, farmsteads, and cropland. Sediment leaving the watershed and deposited in the Great Salt Lake and surrounding saline wetlands will be reduced 16,900 tons per year.

CROPLAND TREATMENT MEASURES

Proper residue management will improve the surface condition of the soil and help maintain a satisfactory hydrologic condition on the surface. Improved soil condition will reduce the detachment potential of soil particles, thus decreasing sheet erosion, and improve water intake. Maintenance of a satisfactory hydrologic condition will increase the surface roughness, increase infiltration, and reduce surface runoff.

On-farm terraces will break up the cropland slope length, store water and sediment from the area above each terrace, and protect the area between terraces from gully erosion and sediment damage. The terraces will prevent damage from runoff up to that expected from a 10-year, 5-day rain plus snowmelt on frozen ground.

CROPLAND STRUCTURAL MEASURES

Level diversions will supplement on-farm terrace systems and other supporting land treatment measures in protecting cropland from water and sediment runoff from rangeland and cropland too steep to terrace. These diversions will provide protection from the damage caused by runoff from snowmelt on frozen ground combined with a 25-year 5-day rain.

RANGELAND TREATMENT MEASURES

The rangeland treatment measures will reduce undesirable plant growth, permit regeneration of native grasses, or increase vegetative cover by seeding of adaptable desirable plants. Proper grazing use and well managed grazing systems will improve forage production and restore the soil water-storage capacity.

Improvements in range condition will also benefit wildlife by providing a greater variety of food and cover.

WILDLIFE AND RECREATION

Where level diversions cross moderately deep gullies, water may be impounded, throughout most of the dry summer months. The location of these structures in relation to food and cover on rangelands, and food on croplands, may improve the production and survival of upland game bird broods. The number of diversions storing water and the amount stored is dependent upon annual precipitation patterns.

As individual landowners install livestock watering ponds to facilitate proper range use, upland game birds, big game, and other animals will utilize these water supplies. Unfarmable sections of both level diversions and on-farm terraces (approximately 40 to 50 acres) will be seeded to grass and will provide food and cover for wildlife. Reduced sediment yield and downstream deposition will reduce damage to the limited saline wetlands in the Salt Wells area and on the shores of the Great Salt Lake.

There is no anticipated increase in the development of recreation facilities.

ARCHEOLOGICAL AND HISTORICAL

Known areas of unique scenic value which may be affected by this project are limited to natural geologic terraces and related features which were formed during the Lake Bonneville era. Protection of these features will be considered during layout of structural measures and on-farm terraces. There are no known historical or archeological sites in the watershed, therefore there will be no project effect. Any historical or archeological features discovered during or prior to project installation will be protected.

OTHER ENVIRONMENTAL EFFECTS

Construction of structural measures will disturb approximately 400 acres of cropland. On-farm terrace construction will disturb approximately 2,400 acres of cropland. The construction activities will effect erosion rates, and air pollutants about the same as farming operations on the same size area.

ECONOMIC AND SOCIAL

Secondary effects will result within the influence zone from the increased sales and services associated with increased crop production. The transportation and processing of additional crop production will stimulate the economic condition of the presently established firms and individuals and will have a multiplier effect through all the stages and individuals utilized to get production to consumers.

PROJECT BENEFITS

Total flood prevention benefits include those from erosion control, reduction of sediment deposition, increased infiltration of precipitation available for consumptive use by crops, and secondary benefits. The total annual benefit from structural measures is estimated to be $100,470.

Floodwater damage is directly related to that from erosion and sediment. All damage reduction benefits are evaluated as resulting from sediment and erosion. A separate analysis was not made of floodwater effects.

Control of sheet and rill erosion will reduce the rate of soil deterioration. The effect of keeping the soil in place and maintaining fertility will provide an annual benefit of $43,880. This will result in an increased net return to farmers.

Reduction of gully erosion will result in benefits of $5,540 per year. This results from a reduction in costs to farmers for replacement and repair of farm machinery necessitated by rough surface conditions of farm land. There will also be improved efficiency in farm cultural and harvesting operations.

Reduced sediment deposition will result in benefits of $2,760 per year. This will be from reduced sediment deposition on farmsteads, roads, and utilities that must be removed at private or public expense.

More intensive land use and increased yields will result in net benefits of $35,570 per year. There will be additional benefits from installing extensive on-farm land treatment practices in addition to benefits for structural measures.

Local secondary benefits from installation of structural measures is estimated to be $12,720 per year. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.

COMPARISON OF BENEFITS AND COSTS

The average annual benefits are made up of $87,750 in primary benefits and $12,720 in secondary benefits. The total average annual cost is $25,960. The ratio of benefit to costs is 3.9 to 1.0. Without the inclusion of secondary benefits, the benefit to cost ratio is 3.4 to 1.0. The average annual benefits and costs are shown in Tables 4 and 6.

PROJECT INSTALLATION

Existing conservation programs of the Northern Utah Soil Conservation District and federal agencies cooperating in this project will continue at the same rate during implementation of the watershed work plan.

Acceleration of rangeland treatment measures will begin during the first year of the project and will be completed during the first five years of the installation period. Treatment and adjustment in range use will take into consideration the effect on normal operations.

Land treatment measures on at least 75 percent of the land above each diversion structure will be installed prior to diversion construction to insure that sediment source areas are controlled. Acceleration of cropland treatment measures, consisting of necessary tillage operations supported by level terraces, will begin simultaneously with installation of the level diversions on the area immediately below the diversion. The diversions will provide protection to the land down the slope so that treatment measures can be installed. Assistance on management practices will begin the first year of the project and will be completed during the first five years of the installation period. Terrace construction will begin the first year. During the next four years, terrace construction on land immediately below structural measures will continue in conjunction with installation of structural measures. During the last five years of the installation period, all planned terrace construction will be completed on the lower areas. Construction of terraces will be in sequence starting at the top of the drainage. Construction effects on normal farm operations will be considered in scheduling terrace and structural measure installation.

PLANNING ASSISTANCE

Preparation of resource conservation plans and plan revisions will be accelerated and will be completed during the first five years of the installation period at the rate of four each year.

PRIVATE RANGELAND TREATMENT

Over the first five year period about 8,700 acres of brush management will be carried out and reseeding done on 3,000 acres of rangeland. Planned grazing systems and proper grazing use will be implemented on approximately 8,000 acres during the first five years and will continue to be practiced on all rangeland where these programs have been established.

CROPLAND

About 83 miles of level on-farm terraces will be installed each year during the 10-year installation period. Conservation cropping systems, including minimum tillage, crop-residue management, and cross slope farming will be installed on approximately 21,600 acres by the fifth year of the installation period.

STRUCTURAL MEASURES

In the first year, land rights will be obtained for 30 miles of level diversions. During the second and third years, 30 miles of level diversions will be installed and land rights for an additional 30 miles will be obtained. In each of the fourth and fifth years, 15 miles of level diversions will be installed.

RESPONSIBILITY FOR INSTALLATION

This plan will be carried out as a joint undertaking of private, local, state, and federal interests. Non-federal interests include individual farmers and ranchers, Hansel Valley Watershed District, the Northern Utah Soil Conservation District, and Box Elder County. The assisting federal agency in the Soil Conservation Service. The federal land-administering agencies have concurred in the provisions of the work plan.

Sponsoring organizations will acquire necessary land-rights and water rights (by negotiation or by exercising their rights-of-eminent domain), execute agreements with owners of private lands for installation of the land treatment measures, and cooperate with local, state, and federal agencies concerned with the project. Federal assistance for structural works of improvement (other than information for obtaining land rights) will not be made available until the sponsoring local organization has acquired land rights sufficiently in advance of the scheduled installation of works of improvement to provide a reasonable basis for the orderly design and construction of these measures. Structural measures will be installed under negotiation with disadvantaged contractors through the Small Business Administration or by competitve contract handled by the sponsors.

The Hansel Valley Watershed District is empowered to enter into agreements and contracts, to sue and be sued, has powers of taxation and eminent domain, can enter into special-use agreements with land administering agencies for construction and maintenance of improvements, and can carry out soil and water conservation operations within its boundaries.

To coordinate installation of rangeland treatment, accelerated land treatment and structural measures on private and state lands will require close cooperation and detailing of specific responsibilities of assisting agencies.

Northern Utah Soil Conservation District will:

1. Provide local leadership and direction to continue the going District program at the rate existing prior to implementation of this work plan.

2. Provide local leadership to ensure scheduled installation of accelerated land treatment measures on private land.

3. Encourage and assist other sponsors in meeting their responsibilities for installation of structural measures.

Box Elder County will:

1. Construct necessary road crossings.

2. Operate and maintain these road crossings.

Hansel Valley Watershed District will:

1. Survey, acquire, and record land rights for installation of floodwater diversions.

2. Act as local contracting organization for construction of floodwater diversions and furnish the non-federal share of construction costs.

3. Provide leadership, and encourage landowners to intensify land treatment practices, maintain more crop residue on the soil surface, and install terraces to reduce soil loss from farms.

Soil Conservation Service will:

1. Furnish necessary technical assistance through the Northern Utah Soil Conservation District to private landowners for installation of land treatment measures.

2. Furnish the necessary engineering surveys, designs, construction plans and specifications, and construction supervision for installation of the structural measures.

3. Provide project construction funds in accordance with the Cost-sharing and time schedules set forth herein or as revised by mutual agreement, and in accordance with national priorities.

4. Maintain liaison with sponsors and state and federal agencies participating in the project to the end that unified effort and coordinated action will produce the most effective results.

5. Consult with and assist the sponsoring organizations and local, state, and federal agencies in making desirable revisions or amendments of this plan, if and when circumstances dictate.

FINANCING PROJECT INSTALLATION

All sponsoring local organizations are legally organized under state laws and are empowered and qualified to install, operate and maintain project measures. They have reviewed program costs outlined in Tables 1 and 2, and have participated in cost-sharing decisions. They have given the Soil Conservation Service adequate assurance that their share of the installation costs will be available at the time and in the amounts required.

Installation costs allocated to PL-566 funds will be furnished from funds appropriated under the authority of PL-566, 83d Congress, 68 Stat. 666, as amended. This work plan does not constitute a financial document for obligation of federal funds, and financial or other assistance to be furnished by the Soil Conservation Service is contingent upon the appropriation of funds for this purpose.

Prior to entering into agreements that obligate funds of the Service, the Hansel Valley Watershed District will have a financial management system for control, accountability, and disclosure of PL 566 funds received, and for control and accountability for property and other assets purchased with PL 566 funds.

Program income earned during the grant period will be reported on the sponsors' request for advance or reimbursement from the Service.

Cost-sharing and other assistance currently available through going conservation programs of the Northern Utah Soil Conservation District, Agricultural Stabilization and Conservation Service, Soil Conservation Service, and other federal and state agencies cooperating in this project are an integral part of this plan and as a minimum are expected to be available in the amounts and rates that existed prior to development of this work plan.

LAND TREATMENT MEASURES

The cost of applying land treatment measures on private land will be borne by individual landowners or operators. Cost-sharing is currently available for these conservation practices.

Technical assistance will be provided through the going program of the Northern Utah Soil Conservation District at the current rate for installation of the going program on private land. PL-566 funds will be provided for the additional technical assistance needed for accelerating the rate of installation of these measures.

STRUCTURAL MEASURES

The Hansel Valley Watershed District's share of contract administration will come from available funds collected through assessment made since their organization. Funds needed for land rights will come from existing funds. It is anticipated that most land rights will be granted by easement. The purchase of land for right-of-way will not be required.

PROVISIONS FOR OPERATION AND MAINTENANCE

The operation and maintenance agreement will include specific provisions for retention and disposal of property acquired or improved with PL 566 financial assistance.

LAND TREATMENT MEASURES

Operation and maintenance of land treatment measures on private lands will be carried out by private landowners and operators. This will be according to resource conservation plans developed in cooperation with Northern Utah Soil Conservation District.

STRUCTURAL MEASURES

Operation and maintenance of structural measures will be carried out in accordance with agreements between the Hansel Valley Watershed District and the Soil Conservation Service, executed prior to signing of the Project Agreement. The plan will be written in conformance with the Utah Watershed Operation and Maintenance Handbook. The Hansel Valley Watershed District will secure funds from taxation within the district to perform operation and maintenance.

Inspection for damage will be made annually and after each major flood for a period of three years after installation of structural measures, by representatives of the Hansel Valley Watershed District and the Soil Conservation Service. The Hansel Valley Watershed District will continue to make such inspections, without assistance of the Soil Conservation Service, throughout the life of the structures and furnish the Service a copy of the inspection report. Needed maintenance work will promptly be completed by the Hansel Valley Watershed District.

Operation and maintenance will usually consist of repairing damage from breaks or overtopping of the diversion embankment, cleanout of excessive sediment near swales coming into the storage channel, or repair of erosion damage to the outlets and immediate invirons of the drainage ways damaged from diversion overflow. Estimated annual cost for operation and maintenance of diversions and appurtenant structures is estimated to be $4,940.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST 1/

Hansel Valley Watershed, Utah

Installation Cost Item	Unit	Number		ESTIMATED COST - DOLLARS 2/					
				PL-566 Funds		:	Other		
		Non-Federal Lands	Total	Non-Federal Lands	Total	Lands	Non-Federal Land	Total	TOTAL
LAND TREATMENT									
Land Acres3/									
Cropland	Ac.	24,500	24,500				362,600	362,600	362,600
Rangeland	Ac.	14,000	14,000				80,000	80,000	80,000
Technical Assistance				173,000	173,000		6,500	6,500	179,500
Total Land Treatment				173,000	173,000		449,100	449,100	622,100
STRUCTURAL MEASURES									
Construction									
Diversions & Appurtenant Structures	Mi.	60	60	246,800	246,800				246,800
SUB-TOTAL - CONSTRUCTION				246,800	246,800				246,800
Engineering Services				37,000	37,000				37,000
Project Administration									
Construction Inspection				24,700	24,700				24,700
Other				12,300	12,300		2,500	2,500	14,800
SUB-TOTAL - ADMINISTRATION				37,000	37,000		2,500	2,500	39,500
Other Costs									
Land Rights							14,000	14,000	14,000
SUB-TOTAL - OTHER							14,000	14,000	14,000
TOTAL STRUCTURAL MEASURES				320,800	320,800		16,500	16,500	337,300
TOTAL PROJECT				493,800	493,800		465,600	465,600	959,400

1/ The SCS is the Federal agency responsible for assisting installation of works of improvement.
2/ Price Base - 1974
3/ Includes areas only estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Hansel Valley Watershed, Utah

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Cropland			
Conservation cropping system	Ac.	9,200	640
Crop residue management	Ac.	12,250	860
Minimum tillage	Ac.	3,270	240
Contour farming	Ac.	9,840	690
Terraces	Mi.	10	6,560
Rangeland			
Proper grazing use	Ac.	28,000	1,960
Brush management	Ac.	1,300	5,290
Range seeding	Ac.	1,000	10,700
TOTAL			26,940

1/ Price Base - 1974

TABLE 2 - ESTIMATE STRUCTURAL COST DISTRIBUTION

Hansel Valley Watershed, Utah

(Dollars)[1/]

Item	Installation Cost - PL 566 Funds			Installation Cost - Other Funds			Total Installation Cost
	Construction	Engineering	Total PL 566	Construction	Land Rights	Total Other	
Diversions & Appurtenant Structures	246,800	37,000	283,800		14,000[2/]	14,000	297,800
Sub-total	246,800	37,000	283,800		14,000	14,000	297,800
Project Administration			37,000			2,500	39,500
GRAND TOTAL	246,800	37,000	320,800		14,000	16,500	337,300

1/ Price Base - 1974.
2/ Land rights include values for land obtained by easement and costs for surveys, preparation of easements, recording land rights and road crossing construction.

TABLE 3A STRUCTURE DATA
LEVEL DIVERSIONS
Hansel Valley Watershed, Utah

Diversion No.	Length ft.	D.A. Acres	Storage Cap. Vw, Cu ft/ft	Land Slope %	Height of Fill - ft	Vol. of Fill cu. yd.
1	8,600	405	107	7	3	20,380
2	1,600	26	27	6	1.5	960
3	5,000	196	98	8	2.75	10,850
4	4,200	110	110	4	2.75	6,470
5	4,000	284	76	6	2.50	6,000
6	3,800	45	20	8	1.5	2,430
7	5,000	366	270	4	4.00	16,000
8	5,600	143	62	5	2.25	6,270
9	9,600	566	170	4	3.25	20,740
10	10,000	330	102	7	2.75	20,000
11	5,800	433	164	8	3.5	20,420
12	5,600	82	48	6	2.0	5,380
13	2,600	37	36	3	1.5	1,460
14	4,600	146	72	7	2.5	7,550
15	14,200	403	102	2	2.25	13,210
16	3,000	180	195	3	3.25	6,000
17	2,600	30	25	5	1.5	1,560
18	1,400	32	62	3	2.00	1,160
19	6,000	75	24	4	1.25	2,940
20	6,000	187	97	4	2.75	9,240
21	2,200	23	20	4	1.25	1,080
22	7,200	754	136	5	3.25	16,850
23	3,200	85	66	3	2.0	2,660
24	1,800	56	105	1	1.75	1,170
25	3,200	77	32	4	1.5	1,860
27	4,800	146	75	9	2.5	8,640
28	13,000	686	138	7	3.25	36,140
29	3,400	112	80	4	2.5	4,420
30	4,000	340	118	7	3	9,480
31	3,000	304	220	6	4.00	11,340
32	3,600	170	114	6	3.0	7,810
33	10,000	605	198	4	3.5	25,000
34	6,000	453	166	5	3.5	16,320
36	14,000	830	184	2	3.00	21,840
37	9,200	790	177	5	3.5	25,030
38	7,800	455	105	4	2.75	12,020
39	2,000	212	188	3	3.25	4,000
40	3,200	356	188	4	3.5	8,000
41	4,000	148	79	5	2.5	5,600
42	3,400	358	186	5	3.5	9,250
43	5,000	604	168	5	3.5	13,600
44	15,600	2,006	235	4	3.75	44,150
45	3,000	260	137	4	3.0	5,520
46	4,400	680	227	5	3.75	13,640

TABLE 3A STRUCTURE DATA
LEVEL DIVERSIONS
Hansel Valley Watershed, Utah

Diversion No.	Length ft.	D.A. Acres	Storage Cap. Vw, Cu ft/ft	Land Slope %	Height of Fill ft	Vol. of Fill cu. yd.
47	9,000	725	240	2	3.25	18,000
48	6,800	427	150	3	3.0	11,560
49	10,000	1,054	174	6	3.50	29,600
50	3,400	142	101	6	2.75	6,230
52	4,600	247	129	6	3.25	11,730
53	2,200	140	170	4	3.25	4,840
54	2,600	225	204	2	3.0	4,060
55	2,200	223	234	4	3.75	6,230
56	6,200	440	163	6	3.5	18,350
57	2,000	168	192	4	3.5	5,000
58	1,400	121	187	6	3.75	4,690
59	10,600	481	108	3	2.75	15,050
60	8,000	450	121	5	3.0	16,000

TABLE 4 - ANNUAL COST

Hansel Valley Watershed, Utah

(Dollars)[1/]

Evaluation Unit	Amortization of Installation Cost[2/]	Operation and Maintenance Cost	Total
Diversions and appurtenant structures	18,560	4,940	23,500
Project Administration	2,460	xxxxx	2,460
GRAND TOTAL	21,020	4,940	25,960

1/ Price Base - 1974
2/ 50 years @ 5-7/8 percent interest.

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Hansel Valley Watershed, Utah
(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Erosion			
Sheet (Soil Loss)	71,910	8,290	63,620
Gully (Equipment Operation & Maintenance)	22,260	14,230	8,030
Subtotal	94,170	22,520	71,650
Sediment			
Deposition	6,680	2,680	4,000
TOTAL	100,850	25,200	75,650

1/ Price Base - Current normalized

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Hansel Valley Watershed, Utah
(Dollars) 1/

Evaluation Unit	Average Annual Benefit			Total Annual Benefit	Average 3/ Annual Cost	Benefit Cost Ratio
	Flood Prevention 2/					
	Damage Reduction	More Intensive Land Use 4/	Secondary			
Diversions and appurtenant structures	52,180	35,570	12,720	100,470	23,500	4.3/1.0
Project Administration	xxxxxx	xxxxx	xxxxx	xxxxxx	2,460	xxxxxxx
GRAND TOTAL	52,180	35,570	12,720	100,470	25,960	3.9/1.0

1/ Price Base Current Normalized.
2/ In addition, it is estimated that land treatment measures will provide damage reduction benefits and increased water infiltration benefits of $39,480 annually ($23,470 and $16,010 respectively)
3/ From Table 4
4/ Increased water infiltration benefit

INVESTIGATION AND ANALYSIS

All investigation and analyses were carried out according to criteria and methodology contained in handbooks, memoranda, and other guidelines. Backup documentation is located in Soil Conservation Service files.

LAND USE AND TREATMENT

The Soil Conservation Service and sponsors jointly determined the land use and treatment needs for private land. A soil survey was made as the basic inventory on which to base interpretations needed to determine land use and treatment alternatives.

On cropland the criteria used for residue management systems was the Universal Soil Loss Equation. Acres of cropland requiring adjustments to sustain erosion objectives were determined by solving for the cropping management factor (CM) which is an index of crop rotation, tillage, and residue management.

It was determined from this analysis that land treatment measures would need to be supported with diversions and terrace systems to continue present land use and sustain proper use of the cropland resource.

On rangelands, soils were grouped into range sites. A range site is a distinctive kind of rangeland that differs from other kinds of rangeland in its potential to produce native plants. It is different from other range sites in terms of kind or proportion of plant species or in total annual yield.

Range condition was determined on all rangelands. This is the present state of the vegetation in relation to the potential for each site. The range site and condition inventory gave the decision makers the basic inventory needed to determine treatment needs on rangeland.

It was determined from this inventory which plants to use as key plants for utilization to attain proper grazing use. These plants will be used no more than 50 percent of each years annual growth. Grazing systems will be established on each ranch as an aid to accomplishing proper grazing use.

Areas where brush management will be established were delineated on the planning map. These areas were determined from guidelines of still having 15 percent or more of the better forage species that were present in the climax. Brush will be controlled to the extent of that which occurred in the climax. Areas with less than 15 percent of the potential forage species still present will be seeded to adapted grasses, forbs, and shrubs. Livestock water facilities will be established on the basis that livestock will not travel more than one to one and a half miles to water.

The determination of present wildlife resources, needed habitat improvements, and effects of project alternatives was accomplished by on-site field reconnaissance and several conferences involving employees of the Utah Division of Wildlife Resources, project sponsors, and Soil Conservation Service. Data for estimating the relative abundance of wildlife is contained in the Division's Annual Upland Game Reports. Observations of the effects of similar land treatment and structural measures in adjacent areas is the basis for estimating effects of the works of improvement on wildlife.

ENGINEERING

LAND TREATMENT MEASURES

Level on-farm terraces needed to support tillage operations will be designed and spaced according to Soil Conservation Service Design Standards for Level Terraces in Utah. The Universal Soil Loss Equation was used to estimate erosion rates. With terraces in place, losses were found to be within acceptable limits except on steeper slopes where the minimum practical spacing governs. Additional storage was provided in terraces at these sites to accomodate the increased sediment and to reduce the chance of overtopping. The additional storage is provided by using the following criteria: (1) the channel and supporting ridge will be constructed to fit farm equipment; (2) side slopes will not be steeper than four to one and will be at least twelve feet from toe to ridge; and (3) top of the supporting ridge will be a minimum of three-fourths foot above the natural ground surface. Construction of terraces in the adjacent Blue Creek-Howell Watershed Project has shown these minimum dimensions are necessary to establish successful terraces where topography is mostly undulating.

The Park Valley, Utah climatological station records were used for temperature and precipitation data. These cover 19 years from 1942 to 1961. Volume of runoff, using curve numbers adjusted to frozen ground conditions, was determined from the precipitation equivalent obtained from 5 days of rain and snowmelt. Observations of runoff in the adjacent Blue Creek-Howell Watershed verify these values.

Design dimensions were evaluated for various ground slopes and storage capacities using and Automatic Data Processing program. This was used during planning to obtain quantities and can be used for design dimensions during implementation of land treatment. Verification of location and ground slope by field survey will be required.

DIVERSIONS

The U. S. Geological Survey quadrangle maps, and aerial photographs of the watershed were used to plan structural layout. Each drainage area was studied in detail in the maps and to a lesser degree by field

examination. General location of proposed measures to meet the objectives and limitations defined in the Soil Conservation Service Design Standards for Utah were determined using average slopes and areas from these maps. Exact location for installation of structures will require field surveys. Design dimensions computed by an Automatic Data Processing program using various ground slopes and storage capacities can be utilized for construction after verification of ground slope is made in the field.

Runoff volume values for diversions design were developed as described under land treatment measures. Storage requirements computed during planning can be used for design provided final location and length is not changed extensively.

Diversions will be constructed by excavating a channel across the slope on the contour. The excavated material will be used to form a broad based supporting ridge. The channel and supporting ridge will be constructed to fit farm equipment. Side slopes will not be steeper than four to one and slope length will be at least twelve feet from toe to ridge.

Diversions will be level, with partial end-openings into existing water courses at locations selected to prevent damage at these junctions. Some diversion ends will require mechanical control to convey outflow into the deeper natural channels.

HYDROLOGY

Precipitation equivalent was estimated from rainfall and snowmelt at Park Valley, and analyzed as one of several stations in determining runoff from watersheds above the Snake River Plains. As a result, Park Valley record was used as representative of Hansel Valley.

Winter flood period-of-record occurs in January through April. Analysis for 1, 3, 5, 7, and 10 consecutive-day intervals by the log-normal method and plotted on log-normal-probability paper was the basis for obtaining precipitation-equivalent values. It was rationalized that the 5-consecutive-day rain plus snowmelt could be used. These values correlate with those in the adjacent Blue Creek-Howell Watershed where observations over 10 years have been recorded.

Frozen ground conditions during the dormant season on various hydrologic soil groups were used to develop the runoff-frequency curves with and without project. Soils information was available in the Box Elder County Soil Survey Report. Current interpretation for the soil loss equation was provided by the Utah SCS Program Services Staff.

A range condition survey was made during work plan development. This information was used to reflect hydrologic parameters for current range condition and future trends.

Hydrologic studies for economic evaluation include: (1) infiltration analysis on the cropland, reflecting change due to soil surface

condition improvement from increased residue management; (2) rainfall-yield analysis to determine average annual rainfall and average annual runoff to verify crop yield associated with available moisture; (3) runoff-frequency and sediment-frequency curve analysis on cropland to determine water and sediment storage requirements in level diversions and terraces for installation and operation and maintenance cost estimates.

GEOLOGY

SEDIMENTATION INVESTIGATIONS

Existing sediment data for the proposed project area were limited to a few random rill and gully measurements by local SCS personnel. However, considerable investigations had been made in the Blue Creek-Howell Watershed which is located in an adjacent drainage to the east. This watershed has similar soils, geology, topography, aspects, vegetation, and farming practices.

Sediment rates were determined from gully measurements and surveys of ponds and debris basins in the watershed, in adjacent drainages, and by transposing data from Blue Creek-Howell Watershed. Studies of aerial photographs (1959 and 1966 flights), field observations and interviews with local landowners helped determine present and future physical damage.

Field studies and observations revealed many sections of unstable channels and gullies throughout the watershed. These unstable drainageways have resulted from excessive runoff incident to dry land farming practices. The unstable channel sections are usually of two types: (1) U-shaped channels and gullies with nearly vertical, sloughing banks, eroding in stratified silts, clayey silts, and fine to medium grained sands; and (2) U and V-shaped channels and gullies with steeply sloping banks, eroding in gravelly sands and silts. Generally, bedload is scarce in the first type, however, the deposits in the channel bottom are moderate to highly cemented with lime. The second type has some gravelly bedload and there is limited protection of the bottom by these coarse deposits.

It is predicted that channel and gully erosion will be reduced because of reduced runoff peaks and volumes. On-site erosion is expected to be reduced 60 percent when project measures become fully effective. This reduction will not cause clear water to be flowing in any of the channels or gullies. Therefore, bottom scour and bankcutting is not expected to increase.

Channel investigation will be needed during the design phase of the project to determine the need for, and the types of, diversion outlet structures to be installed to reduce scour, piping, and headcutting.

The Universal Soil Loss Equation was used to determine soil erosion rates on cropland areas, after general sediment rates were established by pond and reservoir surveys. Because of considerable runoff and erosion from snowmelt on frozen ground and rain on snow, the rainfall factor ("R") was considered to be the least reliable. The "R" factor was determined by using several "R" values and comparing the results with erosion rates determined from pond and reservoir surveys. Sediment rates determined from surveys were converted to erosion rates by using a sediment delivery curve based on watershed size. Sediment delivery efficiencies used varied from 10 to 50 percent.

An "R" value of 40 was selected and used to compute erosion rates on a variety of slopes, and slope lengths, under present and future conditions. Slopes ranged from 1.0 to 14.0 percent and slope lengths ranges from 400 to 800 feet. It was estimated that 45 percent of the watershed had slope lengths of 400 feet, 30 percent had slope lengths of 600 feet, and 25 percent had slope lengths of 800 feet, under present conditions. The soil erodibility factor ("K") and the area of the various slope groups were obtained from standard soil survey data. The weighted "K" value (0.38) computed for present conditions was increased for future conditions, without project, to account for reduced organic matter and a probable change in soil structure and intake rate.

SEDIMENT AND EROSION DAMAGES

Sediment and erosion damage areas on which physical data have been computed are as follows:

1. Sheet and rill erosion on cropland.
2. Gully erosion and land area loss.
3. Untillable land and rough land.
4. Sediment deposition damage areas.

Sheet and Rill Erosion on Cropland

Erosion rates computed using the Universal Soil Loss Equation indicate a reduction of 70 percent with treatment on cropland. This reduction was changed to 60 percent to allow for possible broken or overtopped terraces and diversions during events which exceed the design capacity of these structures. Sheet and rill erosion rates are listed as follows:

SOIL LOSS
(tons per year)

Slope (percent)	Present "K" = 0.38	Future Without Project "K" = 0.42	Future With Project "K" = 0.38	
			Computed	Adjusted
1	3,950	3,890	2,400	3,120
3	20,470	19,080	8,140	11,240
5	25,180	26,360	9,520	13,120
8	55,360	58,200	15,040	19,980
14	44,250	48,590	11,240	14,990
TOTAL	149,210	156,120	46,340	62,450
	2/ (138,200)	2/ (144,600)	2/ (42,900)	2/ (57,800)

1/ To allow for overtopping and breaking of some terraces and diversions during events which exceed the design capacity.

2/ Total in cubic yards per year - converting at 80 lbs. per cubic foot.

Gully Erosion and Land Loss

Main gullies were measured in the field and the data recorded on aerial photo contact prints (1959). These prints were later used to determine distances between the measurement points. When computing the area voided by gullying, 20 feet was added to the gully width to allow for the untillable area adjacent to each bank. The computed area was then reduced by 20 percent to allow for geologic erosion prior to the assumed period of accelerated erosion (1922 to 1972). The gully erosion rate was held constant, without project, and reduced 60 percent with project.

Untillable Land and Rough Land

Areas dissected by medium and small gullies were delineated on aerial photographs for five sample areas. Combined acreages of the sample areas were one-third the total cropland. The portion of cropland similar to the sample area was estimated and the data expanded to the total cropped acreage. Areas affected by numerous gullies exceeding 5.0 square feet in cross-sectional area were classified as untillable. Areas affected by numerous gullies with cross-sectional areas ranging from 1.5 to 5.0 square feet were classified as rough land.

Based on this criteria, 760 acres were classified as untillable and 8,920 acres were classified as rough land. The projected future erosion rate was reduced 10 percent, without project. Under project conditions, untillable land was reduced 90 percent and rough land was reduced 60 percent.

Locations of untillable areas will probably remain unchanged under project conditions. Locations of areas classed as rough land may change depending upon the nature or storm and runoff patterns.

Sediment Deposition Damage

Sediment damage was determined by estimating the percentage of total yield deposited in each type of area damaged. Average annual deposition was estimated for road rights-of-way, farmstead areas and fence lines. Approximately 75 percent of the sediment yield is transported out of the watershed area. The majority of this sediment is deposited in the Great Salt Lake where it causes little, if any, damage.

ECONOMICS

The economic analysis was confined mainly to on-site type of damage. Present conditions were surveyed and projected for benefit determinations using future-without and future-with project conditions. Crop budgets utilize current costs and current normalized prices. All effects projected into the future were discounted to present values at 5-7/8 percent interest.

Floodwater damage was associated directly with erosion and sediment deposition so all damages and benefits are assigned to erosion and sediment. The economic analysis was broken into the areas of (1) sheet erosion on cropland, (2) increased infiltration of precipitation, (3) farm machinery ownership and operation cost changes and, (4) off-site sediment deposition. Each analysis area is discussed below:

SHEET EROSION ON CROPLAND

The damage from sheet erosion will be from reduction of soil depth and the associated reduction in crop yield. The area was divided into evaluation units which correspond with land slope. The accelerated damage rate on the steeper slopes was identified with this procedure.

The "dollar effect" was determined from the change in net returns from crop production, projected and discounted, for future-without and future-with project conditions. Crop yields were determined from the depth of soil reduction projected for the 50-year evaluation period. The net effect in the future considered the projected yield reduction from soil loss and the counter affect expected from improved technology for the same evaluation period.

INCREASED INFILTRATION OF PRECIPITATION

The combination of land treatment and structural measures will increase the retention of soil moisture in the root zone on the cropland. The analysis of this is based on the crop yield increase from this increased water infiltration. The monetary effect is based on the value of increased crop yields in net return to the farmers. Discounting for time lag and projection of technological improvements are considered in determining the net project effect.

FARM MACHINERY OWNERSHIP AND OPERATION COST CHANGES

The economic analysis identifies the increased cost of owning and operating farm machinery due to rill and gully erosion on cropland areas. The project effect will increase life and reduce maintenance of machinery, and increase the operation time efficiency. These effects result from improving the cropland surface condition and eliminate many of the rills and gullies formed by surface water runoff. Damage from these rough surface conditions was analyzed from field reconnaissance surveys, acres effected for evaluation periods, and dollar values developed for crop budgets.

OFF-SITE SEDIMENT DEPOSITION

The project will reduce sediment deposition on roads, farmsteads, cropland, and other areas. The economic analysis is based on the benefits from preventing sediment deposition. For this analysis, the project benefit is the change in projected costs of sediment prevention for with and without project.

SECONDARY BENEFITS

The only secondary benefits identified were local benefits in the "stemming from" project class. These are based on 10 percent of the identified primary benefits.

PROJECT BENEFITS

A benefit analysis was made for the entire project system. The project benefits result from installation of structural measures and associated land treatment. Benefits for determining structural measures feasibility were obtained after subtracting the annual cost of associated land treatment measures from total annual benefit. This assumes the land treatment benefit to be at least equal to cost for land treatment measures.

Following is a summary of benefits for project installation:

	Total Project Benefit	Associated Land Treatment Cost	Benefit from Structural Measures
Sheet Erosion Damage Reduction	$63,620	$19,740	$43,880
Increased Water Infiltration (yield & net return increase)	$51,580	$16,010	$35,570
Sediment Deposition Damage Reduction	$ 4,000	$ 1,240	$ 2,760
Change in Farm Machinery operation, maintenance, and efficiency.	$ 8,030	$ 2,490	$ 5,540
Secondary Benefits	$12,720		$12,720
TOTAL	$139,950	$39,480	$100,470

COST ESTIMATES

Preliminary quantities and costs for structural measures were prepared to determine feasibility of the alternatives. Unit costs for each construction item were obtained from costs of similar items installed in recent construction in the adjacent Blue Creek-Howell Watershed Project.

The estimated quantities determined for the selected structural alternatives of level diversions and appurtenant structures can be used during work plan implementation. The average ground slope and length of structure used must be verified by field survey. Quantity variations due to change of either of these parameters can readily be obtained from the Automatic Data Processing program printout used for work plan design.

Estimates include 15 percent of construction costs for engineering services, 15 percent for PL-566 project administration, and 1 percent for other project administration.

COST ALLOCATION AND COST SHARING

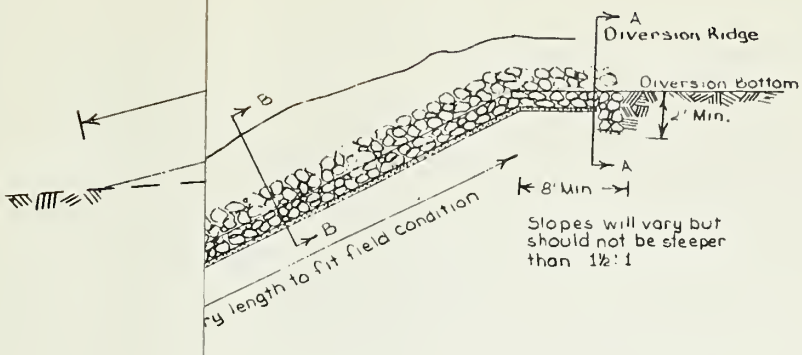
Installation costs for structural measures are allocated to flood prevention. Sharing of costs between PL-566 and other funds is based upon Public Law 566, as amended, and the policy statement of the Secretary of Agriculture.

Cost-sharing for installation of diversions and appurtenant structures is as follows:

	PL-566	Other	Total
Construction	246,800		246,800
Engineering Services	37,000		37,000
Land Rights		14,000	14,000
Total Installation Cost	283,800	14,000	297,800

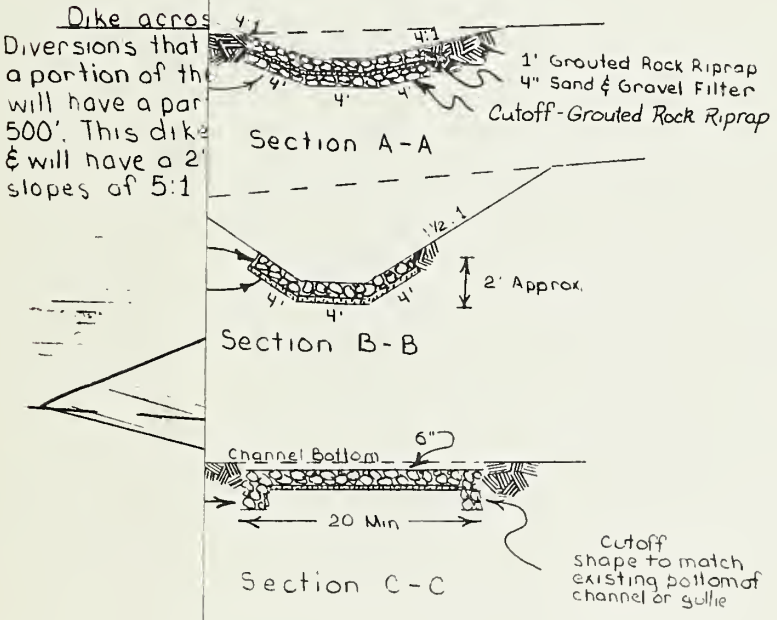
The cost-sharing for Project Administration of structural measures will be as follows:

	PL-566	Other	Total
Project Administration			
Construction Inspection	24,700		24,700
Other	12,300		12,300
Contract Administration		2,500	2,500
Total Project Administration	37,000	2,500	39,500



Along Diversion Outlet
No Scale

Note: Cutoff trench will be filled during the grouting operation. The entire depth will be grouted rock.



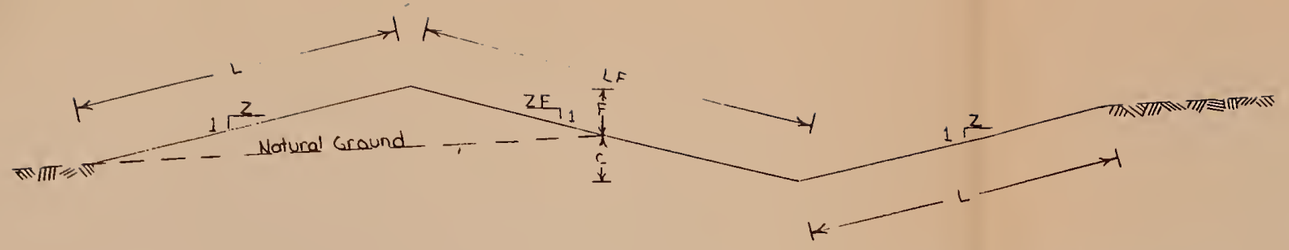
ICAL DIVERSION OUTLET

FIGURE 1

WORK PLAN

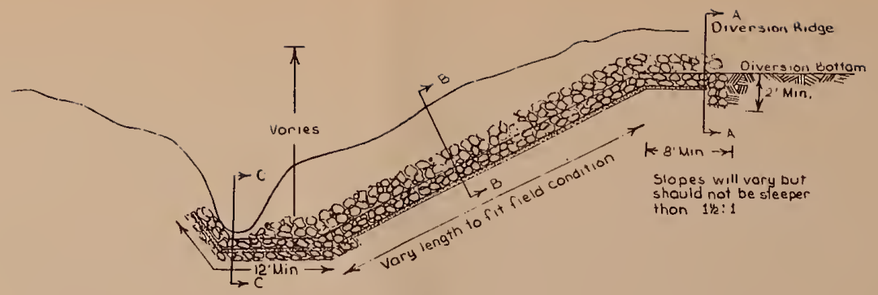
YPICAL STRUCTURAL MEASURES

HANSEL VALLEY WATERSHED



Typical Diversion Cross Section

NOTE: Diversion will be on a level grade with partial blocks spaced a maximum of 500'. This block will be half the depth of the diversion & have a 2' top width with side slopes of 5:1. All slope ratio's shown are the minimum allowable.

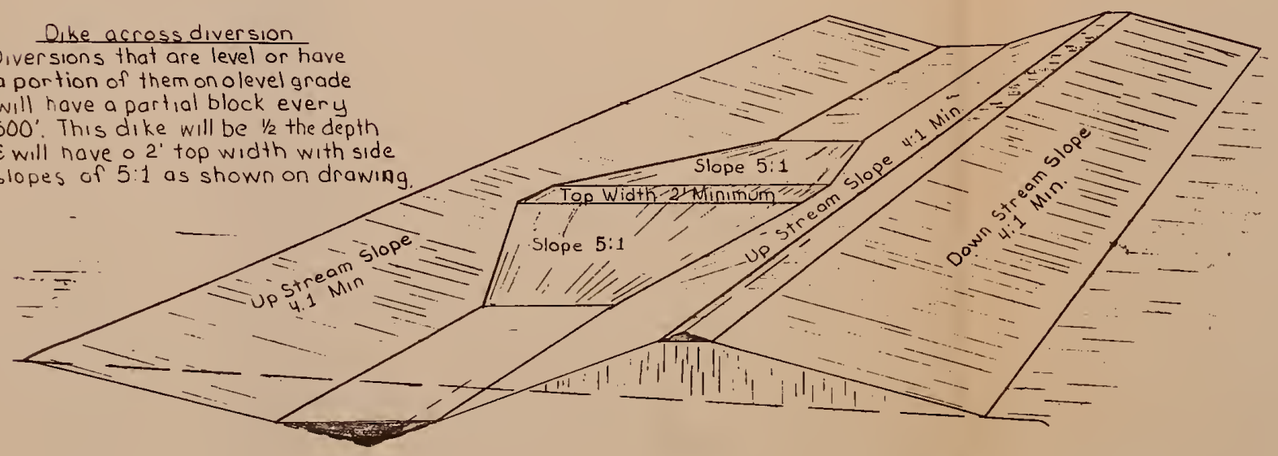


Profile Along Diversion Outlet
No Scale

Note. Cutoff trench will be filled during the grouting operation. The entire depth will be grouted rock.

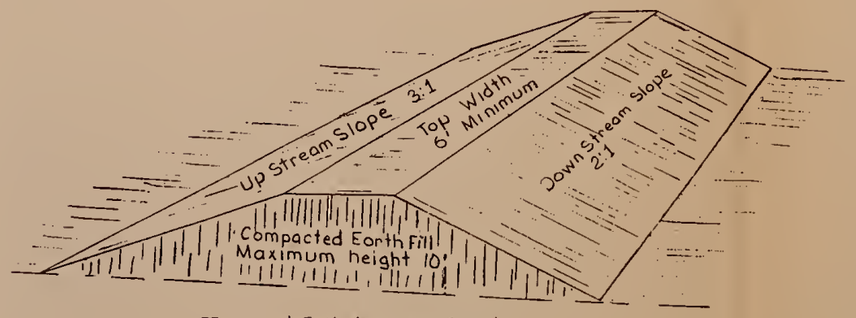
Dike across diversion

Diversions that are level or have a portion of them on a level grade will have a partial block every 500'. This dike will be ½ the depth & will have a 2' top width with side slopes of 5:1 as shown on drawing.

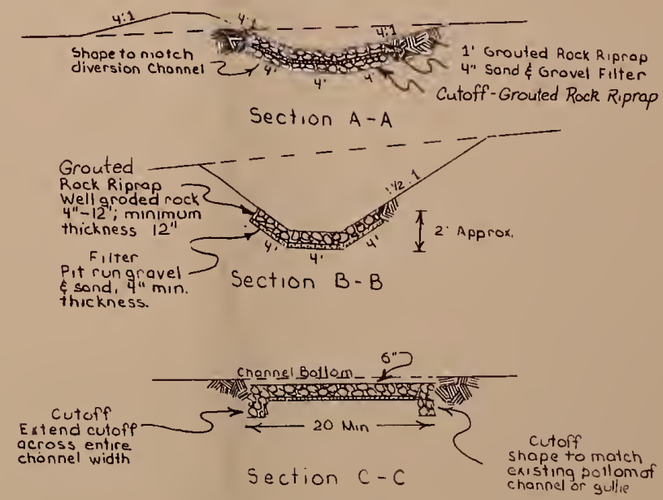


TYPICAL DIKE ACROSS DIVERSION

NOTE: All slope ratios shown are the minimum allowable. Top of fill and bottom of channel may be V shaped for farmability.



Typical Fill Across Swales
For Short Sections



TYPICAL DIVERSION OUTLET

FIGURE 1

WORK PLAN

TYPICAL STRUCTURAL MEASURES

HANSEL VALLEY WATERSHED

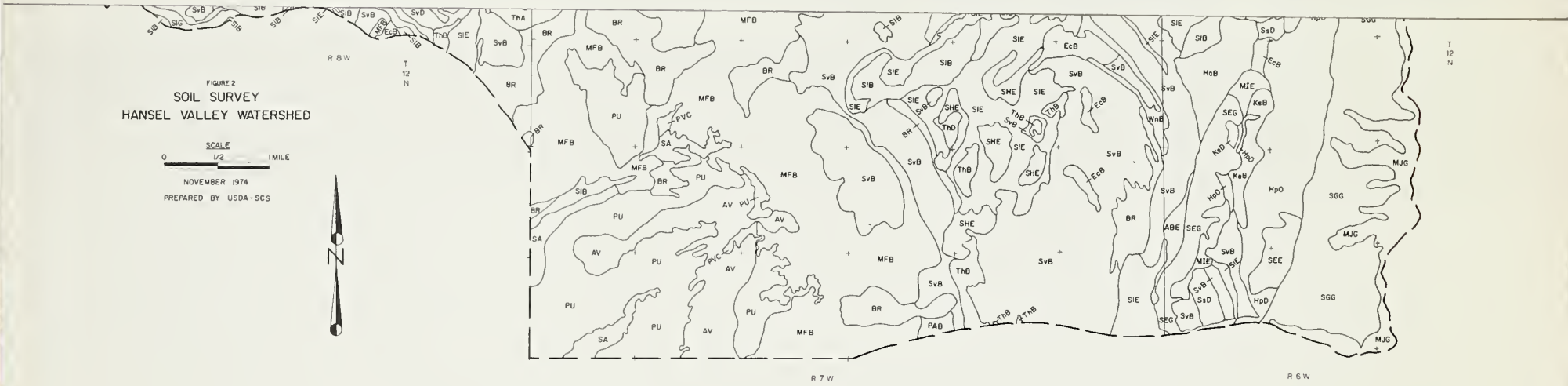


FIGURE 2

SOIL SURVEY

HANSEL VALLEY WATERSHED

SCALE

0 1/2 1 MILE

NOVEMBER 1974

PREPARED BY USDA-SCS

FIGURE 2

SOIL SURVEY
HANSEL VALLEY WATERSHED

SCALE 1/2 0 1 MILE

NOVEMBER 1974
PREPARED BY USDA-SCS

CHARACTERISTICS, PROPERTIES & INTERPRETATIONS OF SOILS IN HANSEL VALLEY

Map Symbol	Soil Name	Soil Profile Description	Depth	Permeability	Drainage Class	Available Water Holding Capacity	K Value Class	Allowable Soil Loss	Runoff Class	Erosion Hazard	Land Capability Units	Range Sites
			(ins.)	ins./hr.		ins. 1/		T/A/Yr. 2/				
AV	Areve silty clay loam	Surface - silty clay loam, about 4 inches thick Subsoil - silty clay loam, about 7 inches thick. Substratum - silty clay loam that that extends to a depth of 60 inches	60+	Moderately Slow	Poorly	3-8	.49	1	Slow	Slight	VIIw-28	Salt Meadow
BR	Brem silt loam	Surface - silt loam about 5 inches thick Subsoil - silt loam, about 7 inches thick Substratum - silt loam, extends to a depth of 64 inches, strongly alkaline between depths of 12-64 inches	64+	Moderately Slow	Moderately Well	4-7	.46	3	Medium	Moderate	IIIw-28 irrigated VIIs-28	Semidesert Alkali Flat
BTG	Broad-Manila Association											
	60% Broad cobbly loam 30 to 60 percent slopes	Surface - cobbly loam, 9 inches thick. Subsoil - gravelly and very gravelly clay loam about 19 inches thick Substratum - very gravelly loam, extends to sandstone bedrock at a depth of about 36 inches, Strongly alkaline	36	Moderate	Well	4-5	(0-9") .28 (9-22") .20 (22-36") .15	2	Medium	Moderate	VIIs-M	Mountain Stony Loam
	30% Manila loam, 25 to 60 percent slopes	Surface - loam, about 13 inches thick Subsoil - silty clay loam, upper 7 inches, silty clay and clay in next 12 inches, stratified Substratum - very cobbly silt loam that extends to weathered sandstone and fractured limestone bedrock at depths of 57 inches	57	Slow	Well	11-12	(0-13") .43 (13-25") .37 (25-57") .43	2	Rapid	High	VIIe-M	Mountain Loam
	10% Inclusions											
OgB	DeJarnet gravelly silt loam 1 to 6 percent slopes	Surface - silt loam about 10 inches thick Subsoil - gravelly silt loam in the upper part and very gravelly loam in the lower part about 24 inches thick. Substratum - very gravelly loam that extends to a depth of 60 inches	60+	Moderate	Well	5.5-7	.32	3	Slow	Slight	IVs-U4	Not assigned
OgD	DeJarnet gravelly silt loam, 6 to 10 percent slopes	(Same as OgB)	60+	Moderate	Well	5.5-7	.32	3	Medium	Moderate	IVs-U4	Not assigned
EcA	Eccles fine sandy loam, 0 to 1 percent slopes	Surface - fine sandy loam about 11 inches thick Subsoil - fine sandy loam about 7 inches thick Substratum - fine sandy laam and very fine sandy loam to a depth of 62 inches	62+	Moderately Rapid	Well	7.5-8.5	.32	3	Slow	Slight	IVc-U	Not assigned
EcB	Eccles fine sandy loam, 1 to 6 percent slopes	(Same as EcA)	62+	Moderately Rapid	Well	7.5-8.5	.32	3	Slow	Slight	IVe-U	Not assigned
EcD	Eccles fine sandy loam, 6 to 10 percent slopes	(Same as EcA)	62+	Moderately Rapid	Well	7.5-8.5	.32	3	Medium	Moderate	IVe-U2	Not assigned
ElB	Eccles loamy sand, sandy variant, 1 to 6 percent slopes	Surface - loamy sand about 8 inches thick. Subsoil - sandy loam about 18 inches thick Substratum - loamy very fine sand, loamy fine sand and loamy sand that extends to a depth of 64 inches	64+	Rapid	Well	5-6	.32	3	Slow	Slight water erosion High wind erosion	IVs-U2	Not assigned
FgD	Forsgren silt loam, 6 to 10 percent slopes	Surface - heavy silt loam about 8 inches thick Subsoil - silty clay and silty clay loam about 44 inches thick. Substratum - silt loam to a depth of 66 inches	66+	Slow	Well	10-12	(0-8") .37 (8-44") .43 (44-66") .49	4	Medium	Moderate	IIIe-U	Not assigned
FgE	Forsgren silt loam, 10 to 20 percent slopes	(Same as FgD)	66+	Slow	Well	10-12	(Same as FgD)	4	Rapid	High	IVe-U	Upland Loam
Gp	Gravel pits	Gravel sand and cobblestone	-	Rapid	Well	2-4	-	-	Slow	Slight	VIIs-4	Not assigned
GcD	Gemson silty clay loam 6 to 10 percent slopes	Surface - silty clay loam about 8 inches thick Subsoil - silty clay & silty clay loam that extends to a depth of 64 inches Substratum - silty clay laam that extends to a depth of 74 inches	74+	Slow	Well	10-14	.32	2	Medium	Moderate	IIIe-U	Upland Loam
GcE	Gemson silty clay loam 10 to 20 percent slopes	(Same as GcD)	74+	Slow	Well	10-14	.32	2	Rapid	High	IVe-U	Upland Loam
GEE	Gemson-Rockland Association, moderately steep											
	50% Gemson-silty clay loam	(Same as GcD)	74+	Slow	Well	10-14	NR	NR	Rapid	High	IVe-U	Upland Loam
	20% Rockland	Quartzite, limestone and sandstone and some basalt	-	-	-	-	-	-	-	-	VIIIs-X	Not assigned
	20% Middle cobbly silt loam											
	10% Inclusions											

CHARACTERISTICS, PROPERTIES & INTERPRETATIONS OF SOILS IN HANSEL VALLEY

Map Symbol	Soil Name	Soil Profile Description	Depth	Permeability	Drainage Class	Available Water Holding Capacity	K Value Class	Allowable Soil Loss	Runoff Class	Erosion Hazard	Land Capability Units	Range Sites
			(Ins.)	Ins./hr.		Ins. 1/		T/A/Yr. 2/				
HaA	Hansel silt loam, 0 to 1 percent slopes	Surface - silt loam, 10 inches thick Subsoil - silty clay loam, about 8 inches thick Substratum - strongly alkaline to very strongly alkaline, silty clay loam to 60 inches or more	60+	Moderately Slow	Well	10-12	(0-10") .37 (10-18") .43 (18-60") .49	3	Slow	Slight	IIc-2 irrigated IVc-U	Not assigned
HaB	Hansel silt loam, 1 to 6 percent slopes	(Same as HaA)	60+	Moderately Slow	Well	10-12	(Same as HaA)	3	Medium	Moderate	IVe-UZ	Not assigned
HaC	Hansel silt loam, 6 to 10 percent slopes	(Same as HaA)	60+	Moderately Slow	Well	10-12	(Same as HaA)	3	Medium	Moderate	IVe-UZ	Not assigned
HD	Harding silt loam	Surface - silt loam, about 5 inches thick Subsoil - strongly saline, silty clay about 14 inches thick Substratum - silt loam and very fine sandy loam to a depth of 60 inches, usually strongly alkaline and saline	60+	Slow above 19 inches Moderate below	Well	10-12	(0-5") .28 (5-19") .40 (19-60") .40	1	Medium	Moderate	VIIs-S8	Semidesert Alkali Flats
HeB	Hendricks silt loam, 1 to 6 percent slopes	Surface - silt loam 6 inches thick Subsoil - silty clay loam to a depth of 67 inches or more	67+	Moderately Slow	Well	10-12	.32	5	Slow	Slight	IIe-M	Not assigned
HeC	Hendricks silt loam, 6 to 10 percent slopes	(Same as HeB)	67+	Moderately Slow	Well	10-12	.32	5	Medium	Moderate	IIIe-M	Not assigned
HeE	Hendricks silt loam, 10 to 20 percent slopes	(Same as HeB)	67+	Moderately Slow	Well	10-12	.32	5	Rapid	High	IVe-M	Not assigned
HKD	Hendricks complex, 6 to 10 percent slopes											
	60% Hendricks silt loam 6-10 percent slopes	(Same as HeB)	67+	Moderately Slow	Well	10-12	.32	5	Medium	Moderate	IIIe-M	Not assigned
	30% Kearns silt loam high lime variant, 6 to 10 percent slopes	(Same as KhE)	60+	Moderate	Well	9-11	NR	NR	Rapid	High	IVe-U	Not assigned
	10% Inclusions											
HpB	Hupp gravelly silt loam, 1 to 6 percent slopes	Surface - gravelly silt loam about 18 inches thick Subsoil - very gravelly silt loam 14 inches or more Substratum - very gravelly silt loam 60 inches or more	60+	Moderately Rapid	Well	4-6	(0-18") .28 (18-60") .37	2	Slow	Slight	IVs-UZ	Upland Stony Loam
HpD	Hupp gravelly silt loam 6 to 10 percent slopes	(Same as HpB)	60+	Moderately Rapid	Well	4-6	(Same as HpB)	2	Medium	Moderate	IVs-UZ	Upland Stony Loam
HuD	Hupp silt loam, 6-10 percent slopes	Surface - 9-16 inches is not gravelly (Otherwise same as HpB)	60+	Moderately Rapid	Well	5-7	(Same as HpB)	2	Medium	Moderate	IVs-UZ	Not assigned
KeB	Kearns silt loam, 1 to 3 percent slopes	Surface - silt loam, 9 inches thick Subsoil - silt loam about 6 inches thick Substratum - silt loam and loam to 60 inches	60+	Moderate	Well	9-11	(0-9") .43 (9-15") .49 (15-60") .55	3	Slow	Slight	IIIe-U	Not assigned
KeC	Kearns silt loam, 3 to 6 percent slopes	(Same as KeB)	60+	Moderate	Well	9-11	(Same as KeB)	3	Slow	Slight	IIe-2 irrigated IIIe-U	Not assigned
KeD	Kearns silt loam, 6 to 10 percent slopes	(Same as KeB)	60+	Moderate	Well	9-11	.43	3	Slow	Slight	IIe-2 irrigated IIIe-U	Not assigned
KeE	Kearns silt loam, 10 to 20 percent slopes	(Same as KeB)	60+	Moderate	Well	9-11	.43	3	Rapid	High	IVe-U	Not assigned
KhE	Kearns silt loam, high lime variant, 10 to 20 percent slopes	Surface - silt loam about 8 inches thick Subsoil - clay loam about 4 inches thick Substratum - clay loam in upper part and sandy clay loam in lower part, strongly alkaline and strongly or very strongly calcareous	60+	Moderate	Well	9-11	NR	NR	Rapid	High	IVe-U	Not assigned
MbE	Manila loam, 10 to 25 percent slopes	Surface - loam, about 13 inches thick. Subsoil - silty clay loam in upper 7 inches, silty clay and clay in next 12 inches, silty clay in lower 10 inches. Substratum - very cobbly silt loam that extends to weathered sandstone and fractured limestone bedrock at depths of 57 inches	57+	Slow	Well	11-12	(0-13") .43 (13-42") .37 (42-57") .28	2	Medium	Moderate	IVs-M	Mountain Loam
MFB	Mellor silt loam, 1 to 6 percent slopes	Surface - silt loam 6 inches thick Subsoil - strongly alkaline, silty clay loam upper part, silt loam low part, 12 inches thick Substratum - silt loam, 48 inches, gravelly loam fine sand 62 inches, usually strongly alkaline and saline	62+	Slow	Well	3-7	55	1	Medium	Moderate	VIIs-S8	Semidesert Alkali Flat

CHARACTERISTICS, PROPERTIES & INTERPRETATIONS OF SOILS IN HANSEL VALLEY

Map Symbol	Soil Name	Soil Profile Description	Depth (ins.)	Permeability ins./hr.	Drainage Class	Available Water Holding Capacity ins. 1/	K Value Class	Allowable Soil Loss T/A/Yr. 2/	Runoff Class	Erosion Hazard	Land Capability Units	Range Sites
MIE	Middle cobbly silt loam 10 to 30 percent slopes	Surface - cobbly silt loam, 7 inches thick Subsoil - cobbly silt loom and very cobbly silt loam about 12 inches thick Substratum - very cobbly loam about 9 inches thick over limestone bedrock at about 28 inches	28	Moderate	Well	2.5-4	.24	2	Medium	Slight	VIe-U	Upland Loam
MIG	Middle cobbly silt loam, 30 to 70 percent slopes	(Same as MIE)	28	Moderate	Well	2.5-4	.24	2	Medium	Moderate	VIIe-U	Upland Loam
MJG	Middle-Broad Association, steep											
	65% Middle cobbly silt loam, 30 to 70 percent slopes	Surface - cobbly silt loam, 7 inches thick. Subsoil - cobbly silt loam and very cobbly silt loam, 12 inches thick. Substratum - very cobbly loam, 9 inches thick over limestone bedrock, depth of 28 inches	28+	Moderate	Well	.25-4	.24	.2	Medium	Moderate	VIIe-U	Upland Loam
	25% Broad cobbly loam 30 to 60 percent slopes	Surface - cobbly loam about 9 inches thick. Subsoil - gravelly and very gravelly clay loam about 19 inches thick. Substratum - very grovelly loam, that extends to sandstone at a depth of 36 inches	36	Moderate	Well	4-5	(0-9") .28 (9-22") .20 (22-36") .15	2	Medium	Moderate	VIIs-M	Mountain Stony Loam
	10% Inclusions											
MKE	Middle-Rock outcrop complex 10-30 percent slopes											
	50% Middle cobbly loam, 10 to 30 percent slopes	(Same as MIE)	28	Moderate	Well	2.5-4	.24	2	Medium	Slight	VIe-U	Upland Loam
	30% Rock outcrop	Basalt	-	-	-	-	-	-	Rapid	NR	VIIIs-X	Not assigned
	20% Rock land and other soils											
MKG	Middle Rock outcrop complex, 30 to 60 percent slopes											
	50% Middle cobbly loam, 30 to 60 percent slopes	Surface - cobbly loam. Subsoil - gravelly heavy silt loam or gravelly or cobbly clay loam	28	Moderate	Well	2.5-4	.24	2	Medium	Slight	VIIs-U	Upland Loam
	30% Rock outcrop	Mostly basalt	NR	NR	NR	NR	NR	NR	Rapid	NR	VIIIs-X	Not assigned
	20% Inclusions											
PAB	Palisade silt loam 1-6 percent slopes	Surface - silt loam, 6 inches thick Subsoil - silt loam, 6 inches thick Substratum - silt loam and loam 12 to 30 inches, and very fine sandy loam 30 to 60 inches, saline in places	60+	Moderate	Well	8-9	(0-12") .28 (12+") .43	5	Slow	Slight	VIIe-S IIIs-3 irrigated	Semidesert Loam
PeB	Parleys silt loam, 1 to 6 percent slopes	Surface - silt loam, 11 inches thick. Subsoil - silty clay loam, 36 inches thick Substratum - loam that extends to 60 inches	60+	Moderately Slow	Well & Moderately Well	10-12	(0-11") .32 (11-47") .32 (47+") .49	3	Medium	Moderate	IIIe-U	Not Assigned
PeD	Parleys silt loam, 6 to 10 percent slopes	(Same as PeB)	60+	Moderately Slow	Well & Moderately Well	10-12	(Same as PeB)	3	Medium	Moderate	IIIe-U	Upland Loam
PeE	Parleys silt loam, 10 to 20 percent slopes	(Same as PeB)	60+	Moderately Slow	Well & Moderately Well	10-12	(Same as PeB)	3	Rapid	High	IVe-U	Upland Loam
PmD	Parleys-Munk complex 6 to 10 percent slopes											
	60% Parleys silt loam 6 to 10 percent slopes	(Same as PeB)	60+	Moderately Slow	Well & Moderately Well	10-12	(Same as PeB)	3	Medium	Moderate	IIIe-U	Upland Loam
	25% Munk gravelly silt loam, 6 to 10 percent slopes	Surface - silt loam 10 inches thick. Next layer - gravelly heavy loam 7 inches thick. Underlying layer - very gravelly sandy clay loam to 32 inches, strongly alkaline and strongly calcareous, Limestone fractured bedrock.	32	Moderate	Well	2-4	(0-17") .28 (17-32") .1	2	Medium	Moderate	IIIs-U	Upland Loam
	15% Inclusions											
PmE	Parley-Munk complex 10 to 20 percent slopes	(Same as PmD) ----------	----------	----------	----------	----------	----------	----------	Rapid	High	IVe-U	Upland Loam
PnD	Parleys-Pomat silt loam, 6 to 10 percent slopes											
	50% Parleys silt loam 6 to 10 percent slopes	Surface - silt loam, 11 inches thick Subsoil - silty clay loam, 36 inches thick Substratum - loam that extends to 60 inches	60	Moderately Slow	Well & Moderately Well	10-12	(0-11") .32 (11-47") .32 (47+") .49	3	Medium	Slight to Moderate	IIIe-U	Not assigned
	35% Pomat silt loam 6 to 10 percent slopes	Surface - silt loam, 10 inches thick Underlying layer: silt loam to a depth of 56", fine sandy loam between depths of 56 and 60 inches.	60+	Moderate	Well	9-11	(0-10") .43 (10+") .55	3	Medium	Moderate	IIIe-U	Not assigned
Pu	Ploys - Salt	Strongly calcareous, mixed lake sediments, silty clay, silty cloy loam or silt loam, very strongly saline	NR	NR	NR	NR	NR	NR	Slow	Slight	VIIIw-S	Not assigned

CHARACTERISTICS, PROPERTIES & INTERPRETATIONS OF SOILS IN HANSEL VALLEY

Map Symbol	Soil Name	Soil Profile Description	Depth	Per-meability	Drainage Class	Available Water Holding Capacity	K Value Class	Allowable Soil Loss	Runoff Class	Erosion Hazard	Land Capability Units	Range Sites
			(ins.)	ins./hr.		ins. 1/		T/A/Yr. 2/				
PVC	Pagel silt loam, ralling	Silt loam to a depth of 60 inches or more, strongly calcareous throughout. A layer of strong lime accumulation begins at a depth of 22 inches. Surface layer is moderately alkaline to strongly alkaline. Between depths of 13 to 60 inches or more soils are very strongly alkaline	60+	Moderate	Well	4-6	(0-4") .49 (4-60") .55	2	Medium	Moderate	VIIs-S8	Semidesert Alkali Flats
PwE	Pamat silt loam, 10 to 30 percent slopes	Surface - silt loam 10 inches thick Underlying layer - silt loam to a depth of 56 inches, fine sandy loam between depths of 56 to 60 inches or more.	60+	Moderate	Well	9-11	(0-10") .43 (10"+) .55	3	Medium	Moderate	IVe-U2	Not assigned
PwG2	Pomat silt loam, 30 to 40 percent slopes eroded	(Same as PwE)	60+	Moderate	Well	9-11	(Same as PwE)	3	Very Rapid	Very High	VIIe-U	Upland Loam
PxE	Pomat-Kearns silt loam 10 to 30 percent slopes											
	50% Pamat silt loam 10 to 30 percent slopes	(Same as PwE)	60+	Moderate	Well	9-11	(Same as PwE)	3	Rapid	High	VIe-U	Upland Loam
	40% Kearns silt loam 10 to 20 percent slopes	Surface - silt loam about 9 inches thick Subsoil - silt loam, about 6 inches thick Substratum - silt loam & loam between depths of 15 and 60 inches	60	Moderate	Well	9-11	(0-9") .43 (9-39") .49 (39-60") .55	3	Rapid	High	VIe-U	Upland Loam
	10% Inclusions											
ReA	Red Rock silt loam, 0 to 1 percent slopes	Surface - silt loam, 17 inches thick. Subsoil - heavy silt loam about 20 inches thick Substratum - silt loam to a depth of 60 inches or more	60+	Moderate	Well	10-12	(0-37") .37 (37"+) .43	5	Slow	Slight	IIc-2 Irrigated IIIe-U	Not assigned
ReB	Red Rock silt loam, 1 to 6 percent slopes	(Same as ReA)	60+	Moderate	Well	10-12	(Same as ReA)	5	Medium	Moderate	IIIe-U	Not assigned
RS	Rockland	Rock outcrop, rock rubble, talus mainly limestone materials, and quartzite and some extremely stony sandstone, basalt land very shallow and conglomerate	NR	NR	NR	NR	NR	NR	Very Rapid	NR	VIIIs-X	Not assigned
SA	Seltair silty clay loam	Surface - clay loam, about 7 inches thick. Between depths of 7 and 30 inches stratified silty clay loam and heavy silt loam. Below depths of 60 inches or more silty clay loam. Entire soil is very strongly saline.	60+	Slow	Poorly	2-4	.55	1	Very Slow or Ponded	No Hazard of Erosion	VIIIw-8	Not assigned
SEE	Sandall cobbly silt loam, 10 to 30 percent slopes	Surface - silt loam about 7 inches thick. Subsoil - gravelly heavy loam, 9 inches thick. Substratum - very cobbly loam, about 19 inches thick extends to limestone bedrock	19	Moderate	Excessively	3-4	.23	2	Medium	Moderate	VIs-U	Upland Shallow Loam (Juniper)
SEG	Sandall cobbly silt loam, 30 to 60 percent slopes	(Same as SEE)	19	Moderate	Excessively	3-4	.23	2	Rapid	High	VIIs-U	Upland Shallow Loam (Juniper)
SFG	Sandall-Broad Association, steep											
	65% Sandall cobbly silt loam, 30 to 60 percent slopes	(Same as SEE)	19	Moderate	Excessively	3-4	.23	2	Rapid	High	VIIs-U	Upland Shallow Loam (Juniper)
	25% Broad cobbly loam 30 to 60 percent slopes	(Same as BTG Broad cobbly loam 30 to 60 percent slopes)	36	Moderate	Well	4-5	(Same as BTG)	2	Rapid	High	VIIs-M	Mountain Stony Loam
SGG	Sandall-Pramo Association, steep											
	45% Sandall cobbly silt loam, 30 to 60 percent slopes	Surface - silt loam about 7 inches thick Subsoil - gravelly heavy loam, 9 inches thick Substratum - very cobbly loam, about 19 inches thick extends to limestone bedrock	19	Moderate	Excessively	3-4	.23	2	Rapid	High	VIIs-U	Upland Shallow Loam (Juniper)
	40% Pramo cobbly silt loam, 30 to 60 percent slopes 7 inches thick over	Surface - cobbly silt loam, 7 inches thick. Underlying layer, cobbly loam 7 inches thick over limestone bedrock	14	Moderately Rapid	Excessively	2-3	.32	1	Rapid	High	VIIs-U	Upland Shallow Loam (Juniper)
	15% Inclusions											
SHE	Sandall-Rock outcrop complex, 3 to 30 percent slopes											
	80% Sandall cobbly silt loam, 3 to 30 percent slopes	(Same as SGG)	19	Moderate	Excessively	3-4	.23	2	Medium	Moderate	VIIs-U	Upland Stony Loam
	15% Rock outcrop	Quartzite, limestone and sandstone and some basalt	NR	NR	NR	NR	NR	NR	Medium	Moderate	VIIs-U	Upland Stony Loam
	5% Inclusions											
SJG	Sandall-Razlee Association, steep											
	50% Sandall cobbly silt loam, 30 to 60 percent slopes	(Same as SGG)	19	Moderate	Excessively	3-4	.23	2	Rapid	High	VIIs-U	Upland Shallow Loam (Juniper)
	45% Razlee cobbly silt loam, 30 to 70 percent	Surface - cobbly silt loam 8 inches thick Subsoil - cobbly silt loam 10 inches thick Substratum - very cobbly silt loam, 12 inches thick over limestone bedrock, a layer of lime accumulation at a depth of 18 inches	30	Moderately Rapid	Well	2-3	.24	2	Rapid	High	VIIs-U	Upland Shallow Loam (Juniper)
	5 % Inclusions											

CHARACTERISTICS, PROPERTIES & INTERPRETATIONS OF SOILS IN HANSEL VALLEY

Map Symbol	Soil Name	Soil Profile Description	Depth	Per-meability	Drainage Class	Available Water Holding Capacity	K Value Class	Allowable Soil Loss	Runoff Class	Erosion Hazard	Land Capability Units	Range Sites
			(ins.)	ins./hr.		ins. 1/		T/A/Yr. 2/				
S18	Sanpete gravelly silt loam, high rainfall 1 to 6 percent slopes	Surface - gravelly silt loam, 10 inches thick Subsoil - gravelly loam, 9 inches thick Substratum - very gravelly sandy loam in upper part and very gravelly silt loam and very gravelly loam in lower part 60 inches or more.	60+	Moderately Rapid	Excessively	4-5.5	(0-10") .28 (10+") .17	1	Slow	Slight	IVs-UZ	Upland Stony Loam
S1E	Sanpete gravelly silt loam, high rainfall 10 to 30 percent slopes	(Same as S18)	60+	Moderately Rapid	Excessively	4-5.5	(0-10") .28 (10+") .17	1	Rapid	High	VIs-U	Upland Stony Loam
S1G	Sanpete gravelly silt loam, high rainfall, 30 to 50 percent slopes	(Same as S18)	60+	Moderately Rapid	Excessively	4-5.5	(0-10") .28 (10+") .17	1	Rapid	Very High	VIIs-U	Upland Stony Loam
SrE	Snowville gravelly silt loam, 6 to 20 percent slopes	Surface - gravelly silt loam, 7 inches thick Subsoil - gravelly heavy loam and cobbly light clay loam about 11 inches thick. Below indurated hardpan about 2 inches thick over basalt	18	Moderate	Well	2.5-3	.32	1	Medium	Moderate	VIIs-U	Upland Shallow Loam
SsD	Sterling gravelly loam, 6 to 20 percent slopes	Surface - gravelly loam, 16 inches thick Underlying layer, cobbly loam to a depth of 27 inches and very cobbly loam between 27 and 60 inches.	60+	Moderately Rapid	Somewhat Excessively	3.5-5	(0-16") .24 (16-60") .20	2	Medium	Moderate	IVs-U4	Upland Stony Loam
SsF	Sterling gravelly loam, 20 to 30 percent slopes	(Same as SsD)	60+	Moderate Rapid	Somewhat Excessively	3.5-5	(Same as SsD)	2	Rapid	High	VIs-U	Upland Stony Loam
Sv8	Stingal loam, 1 to 6 percent slopes	Surface - loam, 6 inches thick Subsoil - loam, 19 inches thick Substratum - loam, upper part loam and very fine sandy loam in lower part, 60 inches or more	60+	Moderate	Well	7.5-9.5	(0-6") .43 (6-60") .55	3	Medium	Moderate	IVe-UZ	Upland Loam
SvD	Stingal loam, 6 to 10 percent slopes	(Same as SvB)	60+	Moderate	Well	7.5-9.5	(Same as Sv8)	3	Medium	Moderate to High	IVs-UZ	Not assigned
ThA	Thiokol silt loam, 0 to 1 percent slopes	Surface - and subsoil, silt loam 20 inches thick Substratum - silt loam reaches a depth of 60 inches or more	60+	Moderate	Well	10-12	(0-20") .37 (20-60") .55	3	Slow	Slight	IVe-U	Not assigned
ThB	Thiokol silt loam, 1 to 6 percent slopes	(Same as ThA)	60+	Moderate	Well	10-12	(Same as ThA)	3	Medium	Moderate	IVe-UZ	Not assigned
ThD	Thiokol silt loam, 6 to 10 percent slopes	(Same as ThA)	60+	Moderate	Well	10-12	(Same as ThA)	3	Medium	Moderate	IVe-UZ	Not assigned
To8	Timpanogos silt loam, 1 to 6 percent slopes	Surface - silt loam, 17 inches thick Subsoil - heavy silt loam about 19 inches thick Substratum - silt loam that extends to a depth of 60 inches	60+	Moderate	Well	10-12	(0-17") .32 (17-36") .43 (36-60") .55	3	Medium	Moderate	IIIe-U	Not assigned
Wn8	Windmill gravelly loam 6 to 10 percent slopes	Surface - gravelly loam, 10 inches thick Subsoil - gravelly loam, about 7 inches thick Substratum - extends to depths more than 60 inches, gravelly fine sandy loam in upper part and loamy very fine sand in the lower part. These soils are strongly to very strongly calcareous throughout	60+	Moderately Rapid	Well	5-7	(0-17") .32 (17-60") .40	8	Slow	Slight	IVe-UZ	Upland Loam
WnD	Windmill gravelly loam 6 to 10 percent slopes	(Same as Wn8)	60+	Moderately Rapid	Well	5-7	(Same as Wn8)	8	Medium	Moderate	IVe-UZ	Upland Loam
WnE	Windmill gravelly loam, 10 to 20 percent slopes	(Same as Wn8)	60+	Moderately Rapid	Well	5-7	(Same as Wn8)	8	Medium	Moderate	VIe-U	Upland Loam

1/ For the profile to a depth of 60 inches loss depth is restricted by hardpan or bedrock.

2/ Tons per Acre per Year

NR - Not Rated

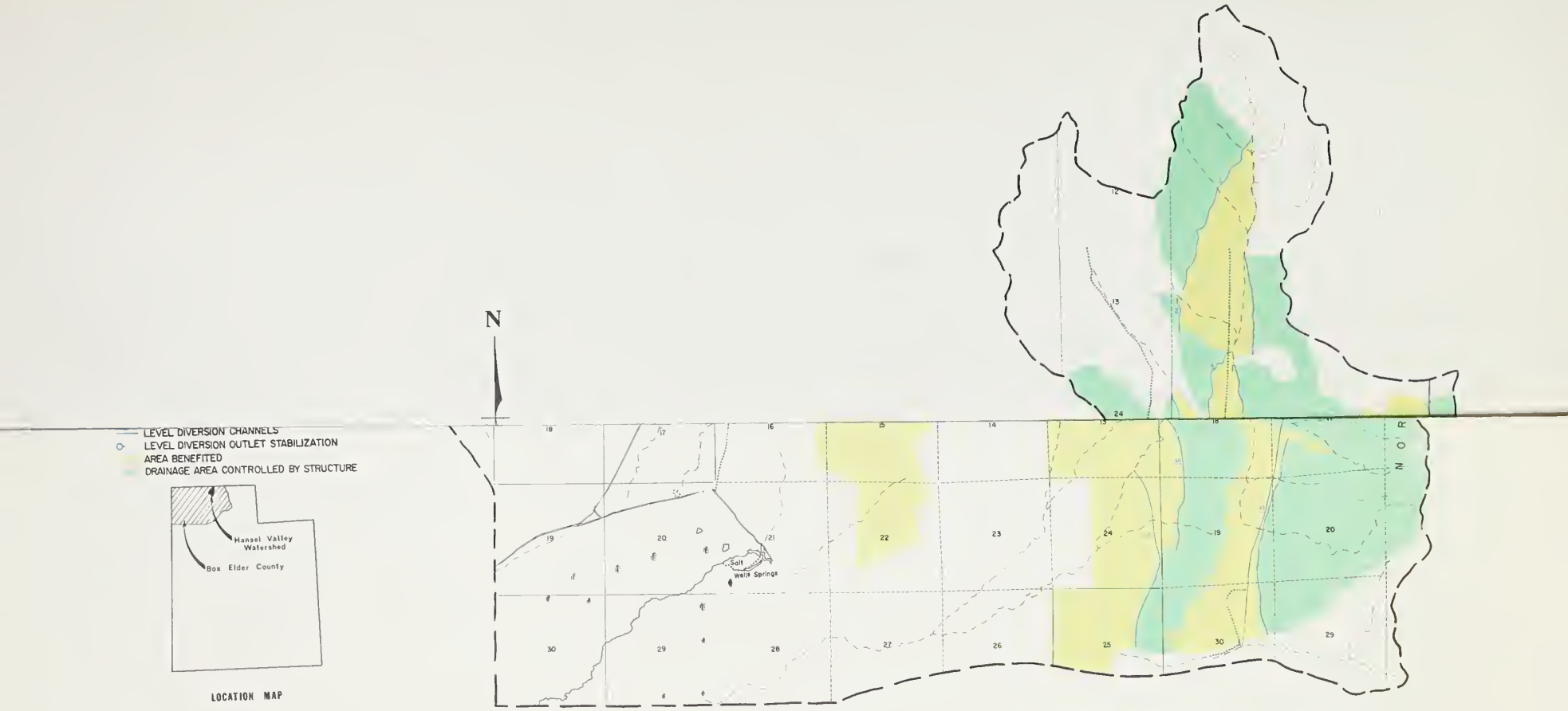


FIGURE 3

PROJECT MAP

HANSEL VALLEY WATERSHED

BOX ELDER COUNTY, UTAH

NOVEMBER 1974

1 0 1 2

SCALE IN MILES

FIGURE 3

PROJECT MAP

HANSEL VALLEY WATERSHED

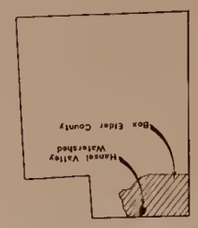
BOX ELDER COUNTY, UTAH

NOVEMBER 1974

SCALE IN MILES

0 1 2

LOCATION MAP



LEGEND

LEVEL DIVERSION CHANNELS

LEVEL DIVERSION OUTLET STABILIZATION

AREA BENEFITED

DRAINAGE AREA CONTROLLED BY STRUCTURE